



SATURDAY, JULY 4, 1874.

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CATECHISM OF THE LOCOMOTIVE.

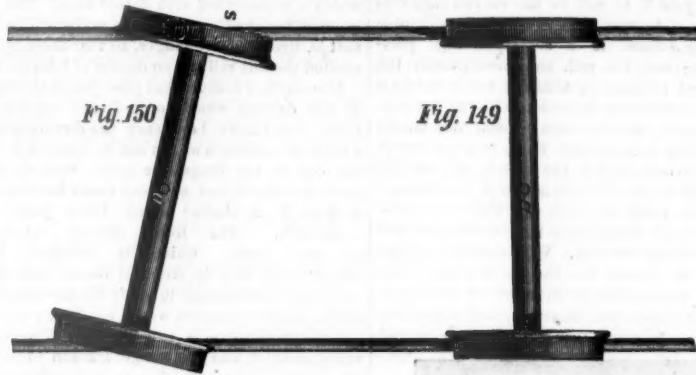
By M. N. FORNEY, Mechanical Engineer.

PART XI.

THE RUNNING GEAR.

QUESTION 241. What is meant by the running gear of a locomotive?

Answer. It means those parts, such as the wheels, axles and



frames, which carry the other parts of the engine. As the Germans express it, it is the "wagon" of the locomotive.

QUESTION 242. How may the wheels be classified?

Answer. As driving and carrying or truck wheels.

QUESTION 243. What service must the driving wheels perform?

Answer. The driving wheels, as indicated by their name, "drive" or move the locomotive on the track, as was explained in answer to questions 61, 62 and 63. As their adhesion depends upon the pressure with which they bear upon

proximate to that of radii of the curves of the track. In figs. 40, 41 and 42, *E E* are the truck wheels, *b b* the truck frame, and *y*, fig. 41, the center-pin, around which the truck frame turns.

QUESTION 246. What service does the truck perform?

Answer. It carries the weight of the front end of the locomotive, and also guides it into and around curves and switches.*

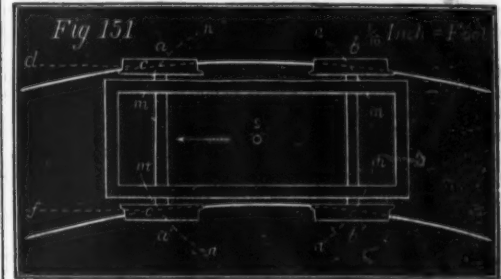
QUESTION 247. How does it perform the latter service?

Answer. It does it very much in the same way as the front wheels of an ordinary wagon enable it to turn around corners; that is, by the truck wheels being attached to a separate frame, which is connected to the locomotive by a center-pin, just as the front axle of an ordinary wagon is connected by the king-bolt.

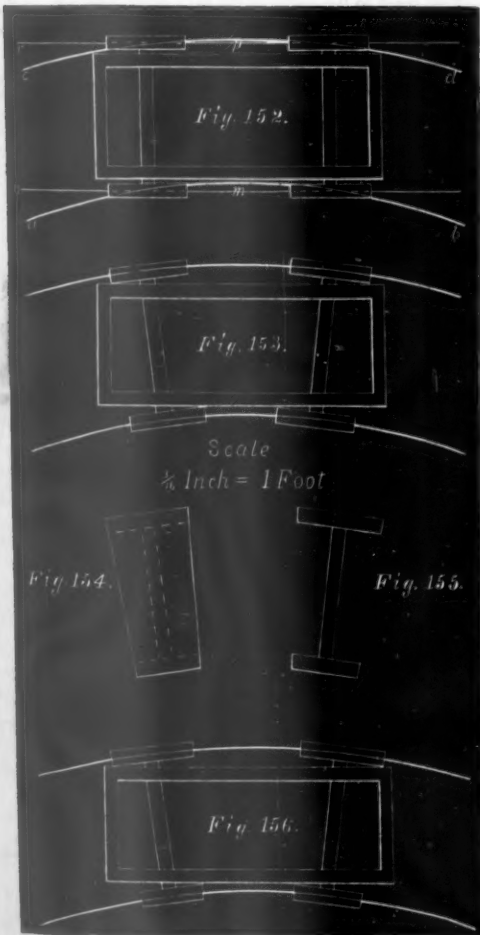
QUESTION 248. Why are two pairs of wheels used on a locomotive instead of one as on an ordinary wagon?

Answer. Because it is necessary to have one pair of wheels guide the other. In an ordinary wagon the front axle is guided by the pole or shafts. Nearly everyone knows the dif-

the axles to each other. In order to make the wheels in fig. 152 roll on the curves *a b* and *c d*, it will be necessary to slide them laterally a distance equal to that between the curves and the straight lines *m o* and *p r*, and as the length of the outside curve is greater than the inside one, if the wheels are fastened to the axle so they cannot turn on it and roll on these curves, either those on the inside or those on the outside must slip a distance equal to the difference in the length of the two curves. Considerable force will therefore be required to overcome the resistance due to the combined lateral and circumferential sliding of the wheels, so that more power will be needed to make them roll in a curve than is necessary to make them roll in a straight line. If, however, the axles are inclined to each other, then the wheels will naturally roll on a curved path, and it will not be necessary to slide the wheels sideways to make them conform to such a path. But if the wheels are all attached to the axles so that those on the same axle cannot turn independently of each other and are all of the same diameters, then either the inside or the outside ones must slip, on account of the path in which the outside ones roll being longer than the inside curve, so that even if the axles are inclined to each other more power will



be needed to roll the truck in a curved path than to roll the wheels shown in fig. 152 in a straight line. It is, however, a fact that a cone or a portion of a cone like that shown in fig. 154 will of itself roll on a curve. It will do the same thing if the middle is cut away, as indicated by the dotted lines in fig. 154 and as shown in fig. 155. If now the wheels are made so that their peripheries* form portions of a cone and the axles are inclined to each other as shown in fig. 156, then there will be no slipping on the track, because the outside wheel, being larger in diameter than the inside one, advances further in one revolution than the other does, and thus rolls on the longest path in the same time that the inside or smaller wheel does. When this is the case, such wheels will roll in a curve



the rails, they must carry either a part or the whole of the weight of the engine.

QUESTION 244. What proportion of the weight of ordinary locomotives is usually carried on the driving wheels?

Answer. The eight-wheeled locomotives which are most commonly used in this country have about two-thirds of their weight on the driving wheels.

QUESTION 245. What is meant by the "truck" of a locomotive?

Answer. It means one or more pairs of wheels which are attached to a separate frame and to the locomotive by a flexible connection, so that the axles are not held rigidly at right angles to the main frame, but can assume positions which ap-

proximate to that of radii of the curves of the track. In figs. 40, 41 and 42, *E E* are the truck wheels, *b b* the truck frame, and *y*, fig. 41, the center-pin, around which the truck frame turns. The movement of the front axle is then uncontrolled, and it is impossible to direct the motion of the vehicle. The same thing would occur with a locomotive if a single pair of wheels were used, and attached in the same way as the front axle of a wagon. Thus if a single pair of wheels were connected to a locomotive by a center-pin, *a*, fig. 149, so that the axle would be free to move around this pin, then if one of the wheels should strike an obstruction, say a stone, *s*, there would be nothing to prevent the axle from being thrown into the position shown in fig. 150, and the wheels would be quite sure to leave the track. When two pairs of wheels are used and both axles attached to the same frame, which is connected to the engine by a center-pin, *s*, between the two axles, as shown in fig. 151, then the wheels in moving round the center-pin must move around the centre *s* in arcs of circles, *m n*, *m' n'*, described from the centre *s*. These arcs, it will be observed, cross the rail. Now if the wheels should move in that direction, the flange of one of them would come in contact with the rail and prevent it from moving any farther. It is therefore evident that the

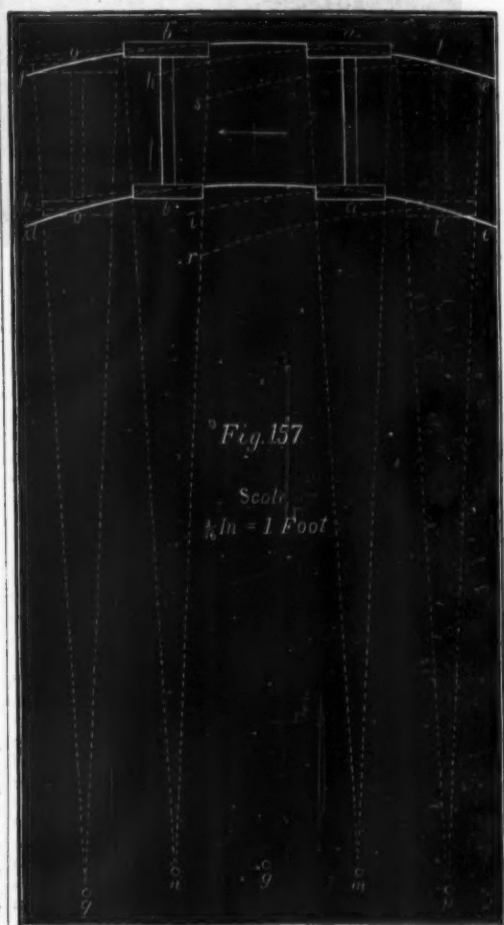


wheels can only move about the center-pin as far as the curvature of the track will permit. Trucks are sometimes used with only one pair of wheels, but the center-pin is then placed some distance behind the center of the axle, or in the same relation to it that the center *s* is to the axle *a a'* in fig. 151. It is evident that if the frame for such a truck turns around the center-pin, the wheels must move across the track in the same way as is represented by the arcs *m n*, in fig. 151. The construction and operation of trucks with a single pair of wheels will be more fully explained hereafter.

QUESTION 249. Why will a locomotive run around curves easier if the front axles are attached to a truck frame which is connected to the locomotive by a flexible connection?

Answer. Because the truck axle can then assume positions which conform very nearly to the radii of the curves of the track, and it is well known that if two or more axles, each with a pair of wheels on it, are attached to a frame with their center lines parallel with each other, as shown in fig. 152, they will roll in a straight line, but if the center-lines of the axles are inclined to each other, as shown in fig. 153, the tendency will be to roll in a curve, the radius of which will depend upon the degree of inclination of

* A switch is a movable pair of rails, by which a locomotive is enabled to run from one track to another.



as easily as those in fig. 152 will in a straight line. The degree of inclination of the axles and of the sides of the cone must, however, vary with the radius of the curve. But if the axles are parallel to each other, and the wheels conical, as represented in fig. 157, they will not roll either in a straight line or in a curve without great difficulty, because if they roll in a straight line, the wheels on one side being larger in diameter than those on the other, either the larger or the smaller ones must slip on the path in which they roll. If they roll on a curve, then each pair of wheels has a tendency to roll in a curve independent of the other, and therefore the wheels must slip laterally if both pairs roll on the same track.

* The periphery is the outside surface on which the wheel rolls. The same part is also called the "tread."

Thus suppose two pairs of wheels, a, a' , and b, b' , fig. 157, to be made conical and attached to a frame so that their axes are parallel to each other. Now each pair of such wheels will have a tendency to roll in circular paths, $a' i, a h$, and $b' k, b j$, the centers of which are at m and n , or at the apices of the cones of which their peripheries form a part. If they are made to roll in a circular path, $c d, e f$, described from a point g , then each pair of wheels must slip laterally over the space between the paths in which they would naturally roll and that in which they are made to roll. Thus the wheel a would slide laterally the distance between the curve $a h$ and $a f$, and a' that between $a' i$ and $a d$; b would slide from $b j$ to $b f$ and b' from $b' k$ to $b d$. It will thus be seen that in order that two pairs of wheels may roll with equal ease in a straight line and in curves, the wheels in the one case must be of equal diameters and the axes parallel, and in the other case the wheels must be of unequal diameters and their axes be radial* to the curve. This is equally true of any number of pairs of wheels. If we have three, four, or any number of axes, with wheels all attached to the same frame, if their axes are parallel and the wheels of the same diameter, they will roll in a straight line; but if their wheels are conical and their axes radial, they will roll in a curve.

For the preceding reasons it is therefore sufficiently obvious that if a locomotive is to run on both straight and curved tracks, on the former the wheels should be of the same diameter and the axes parallel, and in the latter the wheels should be conical and the axes radial.

QUESTION 250. How are the wheels made so that in curves they will act as though they were of the conical form described and on a straight track all be of the same diameters?

Answer. The periphery or tread of each wheel is made conical, but of the same size as the other, and with the small diameter of the cone outside, as shown in fig. 258. On a straight track if the position of the wheels on the rails is such that their two flanges are equally distant from the rails, as

represented in fig. —, and thus increase the resistance and also the danger of running off the track. The increase of resistance from this cause, after the axes reach a certain distance from each other, is greater than the decrease from a closer approximation to the position of radii. In ordinary locomotives it is necessary to place the truck wheels from 5 ft. 6 in. to 6 ft. apart, in order to get the cylinders between them in a horizontal position. This distance apart works very well in practice.

QUESTION 253. What is meant by flange friction?

Answer. It is the friction of the flange of the wheel against the head of the rail. Thus if two pairs of wheels a, a' , b, b' , fig. 151, be placed on a curve and rolled in the direction of the dart, the wheel a will roll towards the outside of the curve until the flange comes in contact with the rail. As already explained, if two axes are parallel to each other, no matter whether the wheels are conical or cylindrical, they must slip laterally in order to roll in a curved path. As the flange must follow the curve of the rail, it forces the wheel laterally and thus compels it to roll in the curved path into which the rail is bent. As the wheel offers considerable resistance to sliding, there is a corresponding pressure of the flange against the rail, and consequently the revolutions of the wheel produce an abrasive action between the two. This action is obviously increased with the distance between the axes, because, as has been shown, the lateral slip of the wheels is then greater than when they are nearer together. It is also obvious that if the wheels are parallel with the rails there will be no abrasive action of the flanges, but that the greater the angle at which the wheels stand to the rails the harder will the flanges rub against the rails, and the greater will be the flange friction. With the aid of geometry it can very easily be proved that the farther apart two parallel axes are, the greater will be the angle of the wheels to the rails on a curved track, and, therefore, the greater will be their flange friction. It must, however, be remembered

be noticed that the flange of the front driving-wheel will come in contact with the inside rail before that on the back wheel can touch it. For this reason the flange of the inside back wheel is kept out of contact with the rail, and the back wheel on the outside of the curve rolls away from the rail, so that there is very little friction of the flanges of the back driving-wheels.

It will also be noticed from fig. 160, that if the radius of the curve is very short, the bend of the rails between the back pair of driving-wheels and the center of the truck is so great that the inside rail will press hard against the flange of the front or main driving-wheel next that rail. This of course produces a great deal of friction, and if the curve is excessively short the flange will mount on top of the rail and the tread of the opposite wheel will fall off from its rail. For this reason the center-pin of the truck is sometimes arranged so that it can move laterally, that is cross-wise of the track. In fig. 160 the center-pin is represented as having moved some distance from the actual center of the truck, which is represented with dotted lines. The front wheels of locomotives are also sometimes made with wide "flat" tires, that is, tires without flanges, so that there will be no friction against the one rail and no danger of falling off the other.

Also another action takes place which facilitates the motion of the driving wheels of ordinary engines around curves. Every one knows how easy the direction in which the front wheels of a common wagon can be controlled by taking hold of the end of the tongue or pole. With the leverage which it gives the wheels and axle can easily be directed wherever it is desired. A similar action takes place in an ordinary locomotive. The front driving axes are guided by the truck, which is attached to the frame ten or twelve feet in front of the driving axle, and thus the truck exerts a leverage to guide the movement of the driving axes, just as a common wagon can be guided by the pole.

If the locomotive is run backward, then none of these advantages exist, and the flange friction of the back driving-wheels is excessive. Engines such as construction locomotives, which run backward as much as forward, wear out the flanges of the back wheels very rapidly on crooked roads.

QUESTION 256. What is meant by the "spread" of the wheels or axes?

Answer. It is the distance between the centers of two axes.

QUESTION 257. What is the "wheel-base" of a locomotive?

Answer. It is the distance between the centers of the front and back or trailing wheels. On ordinary engines, such as that illustrated in fig. 40, it is the distance from the center of the front truck to the center of the back driving-wheels.

QUESTION 258. Is the "coning" of the tread of the wheels of much practical importance?

Answer. There is great difference of opinion regarding it; but even if its action is very beneficial, the advantage is very soon lost, owing to the wear of the wheels. It is, therefore, believed that the advantage is more apparent in theory than in practice.

Contributions.

The Burlington & Missouri River in Nebraska.

TO THE EDITOR OF THE RAILROAD GAZETTE:

In noticing the report of the directors of the Burlington & Missouri River Railroad in Nebraska, in your issue of June 6, you speak of this line and Union Pacific as both lying in the valley of the Platte.

As the roads are, in one place, 56 miles apart, where the Union Pacific is probably seven or eight miles south of the north limit of the valley, you make that valley rather broad.

The Burlington & Missouri follows along the south margin of Platte River for 28 miles, a good deal of the distance at the foot of steep rock bluffs, where there is little or no bottom land, and at some points it is built out in the stream as much as one hundred feet from the south water's edge, to avoid sharp curvature.

It then follows a tributary of the Platte to Highland, 73 miles from Plattsmouth.

This point is at the head of a plain, about six miles long, of maximum grade, or 32 feet per mile.

The line does not again enter the watershed of the Platte for the next hundred miles, and is properly on the divide between the Platte and Republican Rivers, quite important tributaries of the latter stream, lying between the road and the Platte.

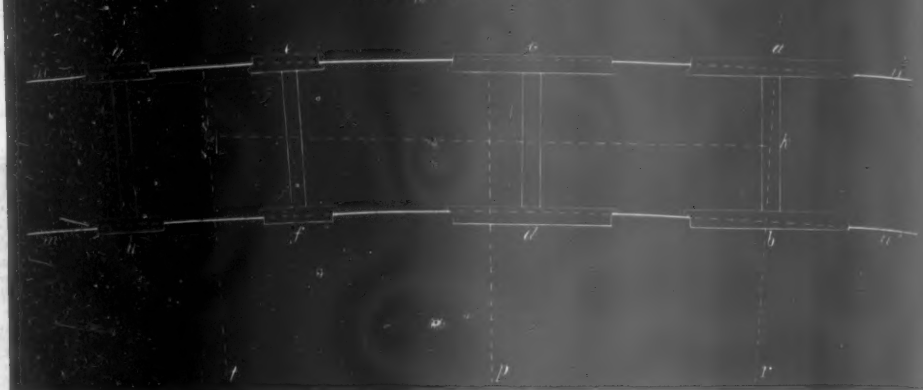
It is quite remarkable that though, after dipping into and climbing out of the valley of the Big Blue, the line follows a "divide route" for ninety miles, and then descends to the Platte valley just east of Lowell (176 miles from Plattsmouth), there is no point between Platte Bridge at Fort Kearney and the Missouri River (182 miles) where grade elevation is as high as that of the bridge, though that is only about ten feet above low water.

You say of the Burlington & Missouri in Nebraska that it is reported to be better built than most new Western roads.

You might have added that no subsidized road had more strictly fulfilled its obligations to the Government and to the public. Certainly Nebraska cannot justly claim that the road by its ownership of vast tracts of land has stood in the way of the development of that State, as all other appliances combined have not been equal to the efforts of this company in increasing the population of the State.

Whether the people who have been influenced by the agents of this company have done just the best thing for themselves in putting, possibly, an unnecessary number of miles of railroad between them and the seaboard, and whether the world generally, and other States in particular, have been best served by the above-named people all going to Nebraska, is a problem I am not now attempting to solve.

Fig. 160.
Scale $\frac{1}{16}$ Inch = 1 Foot



shown, then obviously at the points of contact with the rails the wheels are of the same diameter. That is, a is equal to b . But in running on a curved track, if the wheels are of the same diameter, as has been shown, they will roll in a straight line and consequently towards the outside of the curve. The flange c —supposing it to be outside of the curve—will therefore roll towards the rail, and consequently the outside wheel will rest on the rail at a point nearer the flange, as shown in fig. 159, where the diameter is larger, and the inside one further from the flange where the diameter is smaller than at a and b in fig. 158; and consequently the action of the wheels is the same as though their peripheries were made of the form shown in fig. 157.

QUESTION 251. How are the axes of locomotives made to assume a position radial to the curves in the track?

Answer. This is only done approximately, as the mechanical difficulties in the way of doing it perfectly are so great as to render it impracticable. By attaching the truck to the locomotive by a flexible connection or center-pin, s , as shown in fig. 160 (which represents a plan of the wheels of an ordinary locomotive), it is plain that the truck axes $e f$ and $g h$, instead of remaining parallel to the driving-axes $a b$ and $c d$, will, by turning around the center-pin, s , adjust themselves to the curve so as to approximate as closely to radii as is possible for two axes which are held parallel to each other. Of course the further apart they are the greater will be their divergence from the position of radii, and whether the tread of the wheels be cylindrical or conical the further apart their axes are the greater will be the divergence of the paths in which they would naturally roll from that of any curve on which they must roll. Thus if the axes were twice as far apart as they are represented in fig. 157, and in the position shown in the dotted lines $i f$ and $o o'$ the wheels, if they are conical, would then naturally roll in a curve drawn from the centers p and g . If the wheels are cylindrical, they would roll in straight lines. In either case the divergence of these paths from the curve of the track would increase with the distance between the axes, and therefore the lateral slip of the wheels must be in the same proportion.

QUESTION 252. Is the resistance to rolling diminished the nearer the truck axes are placed together?

Answer. It is, within certain limits. The nearer each other they are placed, the closer will the center-pin of the truck be to the center of the axes. The closer it is to the center of the axle, the greater is the tendency of the wheels to become "slewed," or to assume a diagonal position to the rails, as

* That is, that their centre lines incline towards each other, and if extended far enough would meet at the center of the curve.

that if the wheels are so close together that they are liable to become "slewed," or assume a diagonal position across the rails, as shown in fig. 150, the angle at which the wheels would stand to the rails would thus be very much increased. It has therefore come to be a very generally recognized rule that the centers of axes should never be placed nearer together than the distance between the rails.

QUESTION 254. Is the flange friction of all the wheels of a truck the same on any given curve?

Answer. No; of the front wheels obviously only the flange of the one on the outside of the curve comes in contact with the rail. As the centrifugal force of the engine presses the back pair of wheels towards the outside of the curve, the flange of the outside wheel alone comes in contact with the rail. But as this wheel is constantly rolling away from the rail, obviously the friction of its flange is less than that of the front wheel, which always rolls towards the rail.

QUESTION 255. Can the axes of driving-wheels assume positions radial to the track?

Answer. In ordinary engines they cannot. Various plans have been devised for the purpose of enabling them to do so, but it is only recently that they have met with any success. Some of these plans will be described hereafter. It is, however, of less importance that the driving axes, when they are behind the center of the locomotive, should assume positions radial to a curved track than that the front wheels should. This is illustrated by a common road wagon, as all know the ease with which such a vehicle can turn a corner if we run it with the front axle ahead, and the difficulty of doing so when the back axle is in front. In the case of a locomotive the reason for it is very much the same as that which makes the flange friction of the back wheels of a truck less than that of the front ones. From fig. 160 it will be seen that the outside driving wheels, when the engine is running with the truck in front, are rolling from the rail and not against it. As stated before, the centrifugal force of the engine when in motion has a tendency to throw the wheels towards the outside of the curve. It will also be noticed that the front driving axle is near the center of that portion of the curve which lies between the center s of the truck and the center k of the back axle. If it were in the middle between them, it would be exactly radial to the curve; being near the middle it approximates closely to that position, and therefore the flange friction of its wheels is very slight. It will be noticed that if the flange of the back or trailing wheel on the inside of the curve were not kept away from the rail it would roll toward and impinge against that rail. But it will

The fact that this company's land grant has already paid 40 per cent. of the cost of the road will make it an object of envy and hatred, a "gigantic swindle from its inception," though its projectors were long in doubt whether it would pay to accept the terms of their land grant, and though even as late as October, 1869, one of its chief officers was extremely anxious to "ascertain whether the country west of Range 9 is good enough to justify us in building a railroad through it."

Men were sent to "spy out the nakedness of the land," and after making their report were suspected of too great anxiety to please those by whom they were paid.

After some shaking of heads, the Land Commissioner, Chief Engineer, and several other officials made an expedition, with a military escort to protect their scalps, and concluded the "half had not been told."

Surely, then, this company did not at the outset suppose the Act of Congress granting them a land subsidy gave them remarkable facilities for swindling the Government or people.

They simply risked and won. Congress and the company made a contract that did not, at the time, seem one-sided. The railroad company obtained a franchise that has proved valuable, and are making the most of it.

We hear no complaint about its officers robbing their associates. Both parties to a contract have fulfilled their parts. Who, then, should complain? That future Congresses should profit by the experience of the past, and be very cautious about making any more such contracts, there is no room for a doubt.

A.

Penalty for Injury.

LONDON, June 8, 1874.

TO THE EDITOR OF THE RAILROAD GAZETTE:

While in America public sympathy and recompense invariably go with those who are injured by railroads, here in England I find the weight of evidence reversed—the law in cases of injury presuming on the carelessness of the party injured unless the contrary is clearly shown. Doubtless more care is exercised in guarding against accidents in England than in America, yet it seems to me public sentiment in America should gravitate a little and bestow "equal rights to all." As matters now stand, the railways seem invariably to get worsted, regardless of circumstances.

I inclose slip cut from the *Times*, which illustrates the general view of this matter taken by the courts here:

"ENDANGERING A TRAIN.—At the Owestry Petty Sessions, on Tuesday, David Davies, farmer, Penybank, Berriew, was charged by the Cambrian Railway Company with obstructing their railway with a horse and cart, at a crossing near Welshpool, the previous night, when a train due at Welshpool at 10:20 p. m. ran into it, killing the horse, breaking the cart into pieces, and endangering the safety of the train. He was remanded on £200 bail."

J. K. GRAVES, of Iowa.

Excavations and Embankments.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Among the different methods of laying out work preparatory to excavation and embankment, the description of the method used by the writer at one time may be of interest. In the final location of the line, instead of merely driving a stake at the station, a small plug is driven at the station proper flush with the ground, its position being given by the transit-man, and the numbered station-stake placed about one foot distant to indicate its position.

When the location levels are seen, the rod is each time placed upon this plug, and in addition to this, the leveller is required to re-run test levels and keep up with the transit party, if he can. Of course, during this work, bench marks are made, and carefully tested when the second set of levels are run. We now have a careful set of levels over the whole length of the center line; every station has been tested and is in reality a bench-mark by itself.

Then when we come to cross-section, instead of using the Y level, we have a rod, or flat board, ten feet long, about six inches deep and 1½ inches in width. The length is divided into feet and tenths, and over its center is placed a carefully adjusted spirit bubble, in order that it may be held truly level.

The final set of levels having been run, the grades and center cuts and fills having been determined, the center cuts and fills are placed, opposite their respective stations, at the center of the book. Vertically ruled columns are prepared upon each page representing distances 10 feet apart to the right and left from each other, commencing at the center column ruled for cuts and fills.

The assistant in charge of the cross-section party has two men, one to hold the cross-section rod, and another to take the difference of level, using for that purpose a light pine rod graduated to feet and tenths. Returning to the office, the cuts and fills are readily calculated; generally being placed in red ink, directly under the cross-section as taken. The slope distances then can be easily calculated and the work staked out by two men in the field with an ordinary tape-line whenever required.

The advantages seem to be as follows: its simplicity and system, by which all notes are revised in the office, and only mechanical work done in the field; the referring each cross-section to its own station and reducing any involved error to the smallest limit. In staking out very rough country, it is sometimes an advantage to set the slope stakes at the same time. The distances of 10 feet are only arbitrary, and intermediate distances may be substituted as well as any amount of intermediate distances placed between the stations. This method is the one used by the Chief Engineer of several important railroads in the West, and although claiming no originality may be new to some of your readers.

H.

ANNUAL REPORTS.

Chicago, Rock Island & Pacific.

The report for the fiscal year ending with March, 1874, gives

the following statement of the mileage owned and worked by the company:

	Miles.
Main Line, Chicago to Council Bluffs.....	500.71
Branch—Wilton to Sigourney.....	78.76
Branch—Des Moines to Indianola and sub-branch to Winterset.....	48.24

Total owned..... 627.71

Branch from Bureau Junction to Peoria, leased of the Peoria & Bureau Valley Co. at an annual rental of \$125,000..... 46.75

Total covered by report..... 674.46

Worked under lease by which interest on bonds is paid, Chicago & Southwestern Railway from Washington, Iowa, to Leavenworth, Kan., with branch to Atchison, but not included in this report..... 300.00

Total mileage worked..... 974.46

The equipment by which these 974½ miles of road is worked consisted at the close of the year of:

	1873-74.	1872-73.	Increase.
Locomotives.....	215	197	18
Sleeping coaches.....	11	11	0
Day coaches.....	67	55	12
Combined passenger and baggage.....	0	7	Dec. 7
Baggage, mail and express cars.....	23	23	0
Post-office cars.....	5	5	0
Paymaster's car.....	1	1	0
Total passenger-train cars.....	107	102	5
Box cars.....	2,408	2,408	0
Stock cars.....	622	533	89
Platform and coal cars.....	979	880	99
Caboose and drivers' cars.....	77	77	0
Total freight-train cars.....	4,086	3,898	188
Pile-driving car.....	1	1	0
Wrecking car.....	1	1	0
Gravel car (dumps).....	40	40	0
Total service cars.....	42	42	0

This property is represented by:
Capital stock (\$39,829 per mile owned)..... \$25,000,000
Funded debt (\$14,335 per mile)..... 8,000,000

Total (\$54,167 per mile owned)..... \$34,000,000

The capital accounts show also a balance of \$5,433,071, and the company owns \$4,020,000 of its own stock, which absorbs the larger part of this balance.

The work of two years has been:

	1873-74.	1872-73.
Passenger-train mileage.....	1,007,497	1,038,813
Freight-train mileage.....	3,006,488	3,318,334
Service-train mileage.....	327,095	334,859

Total train mileage..... 4,340,995
Tons carried one mile..... 260,217,943
Passengers carried one mile..... 42,382,171

This shows an increase of about 8 per cent. in train-mileage, of nearly 25 per cent. in tonnage mileage, and of 16½ per cent. in passenger mileage.

The earnings from the year's work were:

	1873-74.	1872-73.
Passengers.....	\$1,621,790 14	\$1,669,570 62
Freight.....	4,597,982 01	5,003,001 07
Mails.....	90,751 24	149,044 61
Express.....	100,650 00	107,098 23
Rents, interest, etc.....	90,567 38	104,734 72
Service of cars.....	12,874 18	8,748 32
Telegraph.....	4,626 91	6,015 74

Total..... \$6,419,231 26
Increase 1873-74 (9.3 per cent.)..... \$7,048,203 30

The expenditures were:

	1873-74.	1872-73.
Working expenses (58.68 per cent. in 1873 and 52.47 in 1874).....	\$3,283,344 91	\$3,698,656 85
Legal expenses.....	23,588 07	40,646 24
Taxes.....	240,480 51	137,576 17

Total (\$54.8 and 55 per cent.)..... \$3,517,789 49
Net earnings..... 2,901,447 77

The company has a land grant amounting to about 464,400 acres. There was sold during the year 24,538 acres for \$200,152—an average price of nearly \$8.25 per acre. Most of the lands now unsold are from 12 to 25 miles from the road, and it is suggested that it may be worth while to construct a branch to make more accessible and therefore more valuable and salable the lands in Shelby and Audubon counties, Iowa.

From the net earnings were paid:

	1873-74.	1872-73.
Dividends.....	\$1,519,944	\$1,459,172
Interest on funded debt.....	621,670	625,125
Peoria & Bureau Valley rent.....	125,000	125,000

Total..... \$2,266,614
Leaving surplus..... 872,653

Making balance at close of year..... \$4,589,683

If the surplus had been divided, it would have added 3½ per cent. to the dividends actually paid.

Expenditures amounting to \$1,380,027 were made during the last year on account of new construction and equipment, \$295,152 going for equipment, nearly \$160,000 for 16 miles of new second track, \$88,800 for 10.84 miles of new sidings, \$186,752 for excess of cost of steel rails used in renewals over iron, \$128,589 for new buildings and machinery, and \$55,756 for the new South Chicago Branch of 6.2 miles.

All the additions to rolling stock were constructed in the company's shops, except 49 platform cars. The renewals of track amount to 48 miles of steel and 34 of new iron, and the mileage of steel rails now in track is 134.

The average receipt per ton of freight and per passenger per mile for five years has been:

Year ending with March.	Passenger.	Freight.
1870.....	4.590 cents.	2.74 cents.
1871.....	3.840 "	2.64 "
1872.....	3.617 "	2.49 "
1873.....	3.598 "	2.29 "
1874.....	3.394 "	2.07 "

The receipt per train mile was \$1.51 and the expense \$0.83 in 1873-74, against \$1.52 and \$0.81 the previous year.

The earnings per mile for the last year were \$10,450.14 gross and \$4,702.57 net.

ELECTIONS AND APPOINTMENTS.

Under the new act of Parliament, the Queen has appointed the Duke of Buckingham, the Earl of Aberdeen, Earl of Delawar, and Earl of Belmore, the Right Hon. Sir Seymour Fitzgerald, the Right Hon. A. S. Ayrton, Lieut.-Gen. Sir J. L. A. Simmons, T. E. Harrison, Esq., President of the Institution of Civil Engineers, and William Galt, Esq., to be her Majesty's Commissioners to inquire into the causes of accidents on railways, and into the possibility of removing any such causes by further legislation.

Col. W. B. Arthur is reported to have been appointed General Superintendent of the St. Louis, Kansas City & Northern Railway, a position which he held for a year or two a few

years ago. Colonel Arthur was formerly General Superintendent of the Illinois Central.

At the first annual meeting of the Railroad Purchasing Agents' Association of the United States and Canada in Chicago, June 17, the following officers were unanimously elected to serve until the next annual meeting: President, G. C. Breed, Louisville & Nashville; First Vice-President, W. S. Cuddy, St. Louis, Iron Mountain & Southern; Second Vice-President, J. T. Sterling, Toledo, Wabash & Western; Secretary and Treasurer, John B. Galloway, Memphis & Charleston; Executive Committee, J. W. Morse, Indianapolis & St. Louis; E. C. Becker, St. Paul & Pacific; E. V. Cherry, Indianapolis, Cincinnati & Lafayette.

At the annual meeting of the Mississippi Valley & Western Railway Company in Canton, Mo., June 23, the following directors were chosen: George Edmunds, Jr., Carthage, Mo.; N. Rollins, Canton, Mo.; Walter J. Hilton, Hannibal, Mo.; Henry S. Carroll, Clarksville, Mo.; John B. Henderson, St. Louis, Mo.; Ira Harris, Jr., Decatur, Ill.; Guy Wells, Keokuk, Ia.; Wm. Chisholm, H. A. Rust, Chicago. The board elected the following officers: President, George Edmunds, Jr.; Vice President, Ira Harris, Jr.; Secretary and Attorney, N. Rollins; Treasurer, O. C. Hale; General Superintendent, E. Pratt Buell.

At a meeting of the directors of the Toledo, Wabash & Western Railway Company in New York, June 27, Messrs. J. R. Cecil, J. S. Casement and Kenyon Cox resigned their positions as directors. To fill the vacancies the board elected George J. Seney, W. B. Isher and A. B. Baylis, all of New York. Of the retiring directors Messrs. Cecil and Cox came into the board last election and Messrs. Cox and Casement are directors of the Canada Southern. Of the new directors, Mr. Seney is an officer of the Metropolitan Bank and Mr. Isher of the Union National Bank in New York. Mr. Baylis was a director up to the last election and is a director of the Chicago & Northwestern and several other companies. The new directors are said to specially represent the bondholders.

At the annual meeting of the Maine Telegraph Company in Bangor, Me., June 24, the following directors were elected: William Galloupe, Albert Holton, Albert W. Paine, Jacob A. Smith, Bangor, Me.; Hiram O. Alden, Wm. H. Simpson, Belfast, Me.; Eion Bradbury, Wm. P. Merrill, Portland, Me.; Edwin F. Littlefield, Winterport, Me. The board subsequently chose H. O. Alden President and Wm. P. Merrill Secretary and Treasurer.

Mr. J. N. Watkins, General Freight Agent of the Missouri River, Fort Scott & Gulf, is appointed General Freight Agent of the Leavenworth, Lawrence & Galveston also, in place of O. B. Peck, resigned. His office is at Kansas City, Mo.

Mr. David P. Clay has been re-elected President and Arthur W. Hooper Superintendent of the Grand Rapids, Newaygo & Lake Shore Railroad.

Mr. Francis B. Miller, late in the employ of the Baltimore & Ohio at Baltimore, has been appointed Assistant Trainmaster of the Pittsburgh, Washington and Baltimore Railroad, with office at Connellsville, Pa.

At the annual meeting of the Ogdensburg & Lake Champlain Railroad Company in Ogdensburg, N. Y., June 18, the following directors were elected: J. C. Pratt, J. S. Farlow, Geo. M. Barnard, E. T. Farrington, Thomas Upham, J. D. Farnsworth, Theo. A. Neal, S. M. Felton, Geo. Lewis, Francis Cox, W. J. Averell, C. T. Hulburd, A. Andrus.

At the annual meeting of the Tuckerton Railroad Company in Tuckerton, N. J., recently the following directors were elected: Archibald B. Pharo, Dr. T. T. Price, Tuckerton, N. J.; John A. Brown, Barnegat, N. J.; Thomas D. Armstrong, Mount Holly, N. J.; H. B. Smith, Smithville, N. J.; Dr. Samuel Ashhurst, Charles T. Parry, Philadelphia; John W. Russell, Rutherford Staynesant, New York. At a subsequent meeting the board chose the following officers: President, A. R. Pharo; Vice President, B. Staynesant; Treasurer, Richard Ashhurst; Secretary and Assistant Treasurer, Theo. T. Price; Auditor, Samuel Ashhurst.

The Springfield (Ill.) Journal says that Mr. O. A. Stephenson, formerly a telegraph operator at Jacksonville, has been appointed General Superintendent of the Chicago & Paducah Railroad.

Mr. J. B. Silkman has been appointed Freight Superintendent of the Erie Railway in place of Mr. A. A. Gaddis. It is reported that Mr. S. Little, Auditor of the Northern Central Railway, who, with Mr. Houston, of the New York & Oswego Midland, has been making an examination of the company's books, will remain with the Erie as Auditor.

Mr. L. D. Rucker, formerly for some years General Superintendent of the Erie Railway, has been appointed General Manager of the Canada Southern.

At the annual meeting of the Grand Rapids & East Saginaw Railroad Company, in Grand Rapids, Mich., recently, Lowell Hall, S. S. Bailey, Wm. F. Innes, Eben Smith, Milton P. Hine, Elisha Mudge and Samuel Reed were chosen directors. The board elected Lowell Hall, President; Eben Smith, Secretary; M. V. Aldrich, Treasurer; Executive Committee, Lowell Hall, W. F. Innes, Elisha Mudge; Attorney, E. Smith, Jr.

The New York State Canal Board has made the following appointments on the Erie Canal: Charles Hiltner, Division Engineer, Eastern Division, in place of J. N. Greene; G. E. Babcock, Resident Engineer at Albany; E. F. Rigney, Weigh Master at Rochester, in place of W. F. Swarts, resigned.

The officers of the newly organized Indianapolis & Western Railway Company are: President, Wm. H. Durham; Secretary, B. C. Hobbs; Treasurer, J. B. Jardie; Chief Engineer, H. C. Moore.

Mr. James M. Hall, for a few months past General Ticket and Passenger Agent of the Canada Southern, has accepted a position as Chief Clerk in the general ticket office of the Toledo, Wabash & Western Railway.

PERSONAL.

Mr. Jacob Huy has resigned his position as Master Car Builder of the Mobile & Ohio Railroad and has accepted a position in the Light House Department.

Mr. David Knotts, a director of the Maryland & Delaware Railroad Company from its first organization, died at Hillsborough, Md., June 24, at the age of 80 years.

Bluford Wilson, Esq., the new Solicitor of the Treasury, succeeding Banfill, is a director of the St. Louis & Southeastern Railway Company and a brother of its Vice President, Gen. James H. Wilson, and is a young, able and energetic man.

The Vacuum Brake.

The Connecticut River Railroad Company has been experimenting with an arrangement intended to do away with the sharp hissing noise of escaping steam which accompanies the use of this brake, and to which great objection is made. The method tried is to attach a triple-box to the cab of the engine just where the pipe of the brake comes through. The steam expelled from the steam-jet enters the inner box, from which it slowly escapes into the middle one, and at last reaches the outside. The effect of this box arrangement is said to be to completely deaden the noise of putting on the brake, and the invention bids fair to be extensively adopted.



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CONTENTS.

ILLUSTRATIONS:	Page	Page
Catechism of the Locomotive	261	Elections and Appointments
Check-Chains	265	Personal
Prismoidal Formula	264	The Scrap Heap
CONTRIBUTIONS:		Traffic and Earnings
The Burlington & Missouri River in Nebraska	263	Chicago Railroad News
Penalty for Injury	263	Old and New Roads
Excavations & Embankments	263	MISCELLANEOUS:
EDITORIALS:		Catechism of the Locomotive
The Erie Railway	264	Comparison of Different Methods of Applying the Prismoidal Formula to Earthwork Computations
Check-Chains	265	The Grand Trunk's Proposal for Locomotives
Record of New Railroad Construction	265	Truck and Car-Body Check-Chains
Editorial Notes	265	
GENERAL RAILROAD NEWS:		
Annual Reports	263	

Editorial Announcements.

Addresses.—Business letters should be addressed and drafts made payable to THE RAILROAD GAZETTE. Communications for the attention of the Editors should be addressed EDITOR RAILROAD GAZETTE.

Contributions.—Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies, the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and in their management, particularly as to the business of railroads, and suggestions as to its improvement. Discussions of subjects pertaining to ALL DEPARTMENTS of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.

Advertisements.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. We give in our editorial columns OUR OWN opinions, and those only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.

THE ERIE RAILWAY.

The annual meeting of the Erie Railway Company approaches, and it seems to be fated that this unfortunate property must again change its management. A little more than two years ago it was rescued from the hands of those who had taken possession apparently because its owners took no interest in it, and we had, especially on the other side of the ocean, wonderful stories as to what the road would do when worked in the interest of its stockholders. We believe that the extravagant hopes then raised have had very much to do in hindering the realization of what the road is really able and should be made to do. The partisans of the company have not often exaggerated the undeveloped capacities of the property, but they have not sufficiently considered, or have failed to make public, the further fact that great outlays are an indispensable preliminary to the development of these capacities, and the not less important fact that large outlays for improvements are necessary not only to increase its profitability but to save it from ruin. The Erie is something like a railroad for which an immense and profitable traffic is waiting, but which, otherwise completed, has no rails laid, and so has only a capacity for great profit when it shall be completed. It is true that the Erie has actually a large traffic for which it receives a large income; but its ability to make a profit from this traffic is greatly limited for the want of costly improvements, and meanwhile its rivals are increasing largely their facilities and reducing the expense and the price of most of that business for which the Erie is a competitor. Of these competing companies it may be said that improvements are indispensable to any increase of earnings; of the Erie, that they are indispensable to its continued solvency. It has long been weighted by the isolation which results from its exceptional gauge, and by the necessity of competing with double-track roads with a single track. Now these double track roads are constructing third and fourth tracks, they have made great progress towards remedying the defective terminal facilities which added largely to the expenses of them all; they are becoming more and more perfect machines for transportation, while the Erie, always inferior in some important particulars, is, comparatively, standing still. There can be but one end to this course, if persisted in, and that is bankruptcy. The stockholders have never sufficiently appreciated this condition of things, or they would long ago have provided the money which will not only render their shares more productive (if "productive"

is a legitimate word in connection with Erie common stock as it is and has been), but save them from utter worthlessness.

When the present administration was installed, it seemed to appreciate sufficiently the capacities of the road and the requirements for developing them. President Watson early said that he would need money and a great deal of it to make the best of the property. He said and was, we believe, justified in saying that the thirty or forty millions needed for improving the road would not only be sure of earning its own interest, but also of adding largely to the surplus divisible among the shareholders. He neglected, however, to point out the danger of omitting expenditures for new construction. Indeed, he put the question somewhat in this way: Either a large amount of new capital may be expended, enabling the property to earn a large dividend on its shares, or the road can be left pretty much as it is, with a small dividend on its shares. We believe that he made a capital error in presenting the latter alternative, for we believe that it does not exist. The real alternative was—and is—more capital and a value for the shares, or the maintenance of the present condition and bankruptcy.

Still, he would have been a bold man who would at that time have told the Erie shareholders the naked truth. The shares had risen after the *coup d'état* by which Gould was displaced to about 75, or more than 100 per cent.—a value which could only be justified by something like a certainty of a regular 7 per cent. dividend. To say that this stock is valueless unless it can be given value by an immense loan is not a pleasant task for the newly-chosen executive of the shareholders. Indeed, such an assertion by him would have very largely reduced the market value of these shares and earned him the curses of hundreds of the shareholders. At least the word was not said, and perhaps it was not believed in, and the shareholders, reputed to command, by ownership or influence, almost unlimited capital, have never been roused to a vigorous effort to raise the money which alone can save them. We do not forget that there was really a good deal of money raised, and that but for the Dunan charges the road would now have money enough to make fair progress this summer. But the Dunan charges, at least those parts of them which had an actual effect, gained all their strength by what appears to have been an attempt to show that the shares could earn something even without any further improvement of the road—to conceal, or rather to keep out of sight, the fact that the road had greatly fallen behind in comparison with its competitors.

Doubtless another motive for cherishing the belief that the shares had a present capacity for earning dividends was the effect of the prevalence of such a belief in negotiating a loan. The average investor is not likely to be attracted to a loan which is necessary to save a company from bankruptcy, though in fact it may be perfectly good, and incomparably better secured than hundreds of millions of railroad bonds which have recently sold readily at home and abroad.

But it is the holders of Erie shares who should be depended upon to take up the new Erie loans. Other securities may be more attractive to others, but none can be so profitable to them.

Whatever mistakes may have been made by the retiring President in representing the condition of the property to its proprietors, he deserves the credit of having made one of the most vigorous and well-planned efforts on record at a reform in administration, which, unfortunately, there has not been time to carry out to full success. Indeed, there were doubtless some grievous mistakes made which are hardly yet repaired; but considering the condition of things when the management was changed, and the desperate resistance made to some of the most important reforms by almost every one who dealt with the company—including really a great army of people, and some of them very influential—perhaps the progress made is quite as great as could have been expected. Certainly it has been of a kind which has required rare administrative qualities, and a courage, persistency and strength of will only too rare among executive officers. If there has been or seemed to be sometimes a failure to carry through some of the reforms begun, perhaps it should be credited to the protracted absence of the President on his financial errand. We doubt whether any man ever made a more earnest effort to secure the skillful and honest working of a railroad, and we count it a misfortune that Mr. Watson cannot remain to perfect and carry out his plans, which promised, eventually, to embrace many features worthy of general imitation, and to remedy some of the most glaring defects of American railroad administration.

Announcement has been made of the directory which, it is said, is to be chosen at the approaching election. It is notable chiefly for the entrance and prominent position of men connected with the Pennsylvania Railroad Company, who may, it would seem, find it hard to harmonize their positions in the managements of two of the competing great trunk lines. When Mr. James McHenry was in this country a few weeks ago, he said that the management of the Erie after the *coup d'état* was first offered to Commodore

Vanderbilt, who refused to add to his cares so enormous a burden. It is said that Mr. Thomas A. Scott was expected to accept an election in place of Mr. Watson before the death of the late President of the Pennsylvania Railroad Company, and it is presumed that Mr. Hugh J. Jewett is Mr. Scott's choice for the position. Mr. Jewett needs no introduction to people of the Ohio valley, for he with his brother Thomas L. Jewett have been prominently connected with several railroads in that part of the country, chiefly with those which make up the Pittsburgh, Cincinnati & St. Louis and its leased lines, a company which the Pennsylvania Railroad Company has for many years controlled by the ownership of its shares, and which now includes one of the largest systems of lines in the country, forming the chief connections of the Pennsylvania Railroad to Cincinnati, Indianapolis, Louisville, St. Louis, Peoria, and Rock Island, with a secondary route to Chicago. Mr. Jewett is President of this company, though how far its combinations and consolidations are due to him, we cannot say. He is also a popular politician, having just resigned his position of member of Congress from the Columbus district, where he has seemed pretty sure of an election whenever he was willing to accept a nomination.

The recent lease of the Atlantic & Great Western by the Erie more than ever complicates the relations of this company with the Pennsylvania. The latter has the shortest route from St. Louis, Louisville, Indianapolis, Cincinnati and Columbus to New York, by way of the Pittsburgh, Cincinnati & St. Louis; and it is just from these places that most of the through traffic of the Atlantic & Great Western and its leased line, the Cleveland, Columbus, Cincinnati & Indianapolis, chiefly comes. One of the English papers, usually well informed as to the plans of the Atlantic & Great Western, intimates that the Pennsylvania is to give the Erie a route to Chicago, but for what consideration it does not say. Such a route would be more valuable to the Erie than any other one thing probably, if it had the Erie gauge. The company gets pretty fair treatment from the roads west of Buffalo, doubtless, but it would be able to use 790 miles instead of 422 miles of its own road if it could have the use of the Pittsburgh, Fort Wayne & Chicago from Crestline to Chicago, instead of depending on the different lines between Buffalo and Chicago, and would besides be able to earn something from Chicago and Cleveland business. It can make a Chicago route either by way of Crestline or Mansfield, however, as follows:

	Miles.
New York to Salamanca (Erie)	413
Salamanca to Cleveland (A. & G. W.)	213
Cleveland to Crestline (C. C. & L.)	73
Crestline to Chicago (P., F. W. & C.)	260
New York to Chicago	979
	Miles.
New York to Salamanca (Erie)	413
Salamanca to Mansfield (A. & G. W.)	209
Mansfield to Chicago (P., F. W. & C.)	293
New York to Chicago	915

The two routes are thus of very nearly the same length, but the former has the advantage of taking in the important city of Cleveland, while the latter reaches no town of half the size between New York and Chicago.

It is not to be expected, of course, that the Pennsylvania Railroad Company is going to give away its traffic to the Erie "in consideration of love and affection;" but the introduction of Pennsylvania men at the head of the Erie management will lead some to suspect that there will be some sort of an alliance between the two companies. An expectation based upon such grounds, however, is not safe to bet upon in the way of stock speculations, as has been proved more than once. The connection between the two may possibly be no closer than heretofore, and unless the Erie's gauge is changed it cannot profit very largely by adding to the connections with which it simply has the privilege of exchanging traffic.

There are so many directions in which the traffic of the Erie may be developed if it shall be properly prepared to carry economically an increased traffic that it will be a pity if it is left as it is. Aside from the larger share of the general through traffic which it might obtain, and which is constantly growing, it has resources peculiar to itself which are as yet but begun to be developed. The chief of these, doubtless, is its coal traffic, which may be made to give a large movement of trains in both directions from the point where it reaches the road, and, if cars can be adapted for carrying grain and stock as well as coal, may fill a part at least of the immense number of cars which, as on all the trunk lines, now go west empty. This coal traffic does something towards balancing the New York Central's much greater advantages for New England business, and deserves special cultivation.

What the future of the Erie is to be, however, seems as much as ever uncertain. We do not even know the policy of the incoming management; we do not know that the shareholders, even if urged by the management, will provide the large capital which seems so sure to make the company prosperous and without which no permanent success seems possible. The property which the new President will have to administer will include 2,012 miles of railroad. It is to be hoped that it may hereafter have a stable as well as a skillful management.

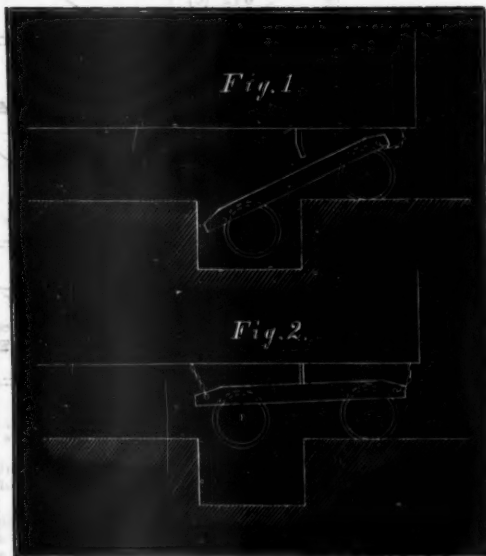
CHECK CHAINS.

On another page we publish the report on this subject made to the Car-Builders' Association at their late convention, and the ensuing discussion. As our readers know, we have frequently urged the attachment of check or safety chains to the trucks of cars and locomotives as a safeguard against accidents caused by the truck getting off the track or the breakage of a wheel, axle or rail. The theory of their action is that, in case the truck of a car or locomotive gets off the track, so long as the truck is kept in line or parallel with the rails there is comparatively little danger, as it will run over the permanent way, that is cross ties and ballast, so far that the train can be stopped without injury to the car or its occupants. If, however, the truck assumes a position at right angles to the track, then, instead of supporting the car, it becomes an obstruction, and either turns over or crushes into the car-body. The advocates of the use of check chains contend that the chains will, if properly proportioned and attached, hold the truck parallel with the track, and thus enable it to carry the car until the train is stopped, whereas without such chains it will be very liable to turn and get across the track, and thus instead of supporting the car will obstruct it. It is also said that in case of a wheel or axle being broken, the chains will sustain one corner of the truck and thus prevent it from falling on the track, and enable it to carry the car until it can be stopped. A similar action of the chains will prevent the wheels from dropping into a culvert or cattle-guard. On the other hand, those who do not believe that check chains afford any protection against accident say that as they are ordinarily applied they are not strong enough to hold a truck if it gets off the track, and that if they are made strong enough the car sills or other parts to which they are attached will be torn out, and thus more damage be done to the car than if there were no check chains.

In support of these views, it will be seen that in the discussion a number of instances were presented by different members, and it was stated in the most positive way that in them check chains had saved cars and passengers from injury and destruction. Similar testimony was given last year at the Convention of the Master Mechanics with the report made to that Association on the same subject. A small minority of those who discussed the subject had not been able to see that check-chains afforded any protection at all. Leaving out of consideration the fact that a majority of those who discussed the subject and who answered the circulars of inquiry were strong advocates of the use of check-chains, the fact that those who are not in favor of their use are trying to prove a negative makes the weakness of their arguments apparent. We have in the report and the discussion the most positive testimony, from intelligent and experienced men, that in numerous cases which have come under their observation check-chains have saved persons and property from injury. We also know from personal intercourse with the same class of men that the volume of this testimony could be immensely increased if the right efforts were made to collect it. Now such testimony is not weakened in the least when those who do not believe in the efficacy of check-chains testify that they have not seen or do not know of any cases in which they have prevented injury to cars in accidents. It is like the celebrated case of the Hibernian who was charged with stealing the axe, although two or three witnesses swore they saw him take it, he was prepared to prove his innocence by bringing a dozen witnesses to swear that they did not see him take it. The testimony given by those who discussed the report referred to is clear and positive evidence regarding the value of such attachments as a safeguard, and it does not weaken that testimony in the least to say that check-chains which are improperly fastened are of no use. As a member remarked, a tow string would be no use; but that does not prove that a chain of sufficient strength properly attached to the car-body and the truck would not be efficient.

The only facts presented by those who are not in favor of using check-chains which had any force were the statements made by Mr. Garey. The experience on his road in several accidents, he said, was that the cars without check-chains were injured less than those with such attachments. He also stated that they used only a single pair of chains to each truck, and that the accident in which the car having such chains was injured was caused by the truck dropping into a culvert. These facts at once brought up the question whether a truck should have chains at each of the four corners or only at two of them. Mr. Wadell called attention to the possibility that in an accident like that referred to by Mr. Garey two check-chains might increase instead of diminishing the danger, whereas four would be a very great safeguard. This view, we think, never received the consideration it deserves. If for example the front wheels of a car-truck should fall into a culvert or cattle-guard, as shown in fig. 1, and have chains only behind, evidently as the car advanced they would pull the back end of the truck over so as to turn it upside down. With check-chains in front,

when the front wheels ran over the culvert they would be supported by the front chains as shown in fig. 2, the weight of the car being in the meanwhile supported on the back pair of wheels. Unless the culvert or other opening in the track was longer than the truck, a similar action would take place after the front wheels had crossed and the back ones were over the opening. If this theory is correct, then obviously it is very important that each truck should have four chains. The difficulty of adjusting four chains so that each of them will bear its portion of the strain is, we believe, not of much practical importance. It certainly is not in the case illustrated above, where two chains alone must sustain the weight of the truck at one time, and therefore to be of any use must be strong enough to do so. If a truck has side motion, and all passenger-car trucks have, if the lengths of the chains at the diagonal corners are adjusted so as to be of the same length, the lateral motion of the truck will compensate for any slight inaccuracy, so that the strain will be equally divided between them in case the truck leaves the rails at a part of the track where there is no opening for it to fall into, and the chains have



simply to keep it in line or parallel with the direction in which it is running. In such a case two of the chains should be strong enough to hold the truck and prevent it from turning around.

Regarding the methods of attaching such chains, some very good plans were proposed. The ignorance or indifference often displayed in the design and construction of these parts is criminal. The simplest and most ordinary knowledge of the strength of materials and the nature of the strain to which they are subjected, should and would show how utterly insufficient some such attachments are. Through this kind of blundering imbecility, all our lives are exposed to danger every time we take a journey.

Record of New Railroad Construction.

This number of the RAILROAD GAZETTE has information of the laying of track on new railroads as follows:

Grafton.—Completed from the Boston & Albany at Grafton Station south 3 miles to Grafton Centre, Mass. **Frankford & Breakwater.**—Extended 8 miles to Millsboro, Del. **Frankford & Kokomo.**—Completed by an extension of 7½ miles from Russellville northeast to Kokomo, Ind. **Chicago & Paducah.**—Extended southward 15 miles to Altamont, Ill., the crossing of the Vandalia Line with the Springfield & Illinois South-eastern.

This is a total of 38½ miles of new railroad, making 603 miles completed in the United States in 1874.

THE PAYMENT OF JULY COUPONS we have looked for this year as unusually significant. Last winter, when rates were extravagantly low for much important traffic, and traffic was unusually light on many lines, there seemed to be danger that not only new companies, but some old ones hitherto regarded as entirely sound, might be compelled to default this July. There was a decided improvement afterwards, but as at this date the country has been suffering from an unusual depression in business for three-fourths of a year, it seemed probable that those which have been able to withstand the evil times so long have seen their worst days and that some at least of the weaker would fail to-day, in addition to the vast number previously in default. We write on the 1st inst., before there has been time to learn fully what the result has been; but so far we have been able to learn of only two new failures, that of the Indianapolis, Bloomington & Western, foreshadowed by the failure of Turner Brothers, its fiscal agents, and that announced in a telegram from London this day received, which says that the "Atlantic & Great Western Railroad Company has declined to receive and pay the coupons of their first mortgage bonds." These are both important ones, as they have each large amounts of bonds outstanding; but if there have been no others, or no important ones, we shall feel that the railroad companies of the country have demonstrated their soundness more completely than could have been expected, and that the future of railroad business is decidedly encouraging.

THE HOOSAC TUNNEL QUESTION, after all, goes over until next year for its final settlement. After an extremely long debate, and after adopting and then rejecting several substitutes for the original bill of the Railroad Committee, the Massachusetts Senate, just at the close of the session, passed a bill for providing for the appointment by the Governor of five commissioners, who shall report to the next Legislature a plan for the utilization of the tunnel, and the organization of one or more through lines. The Commission is also to report upon the various points of inquiry laid down in the Adams bill, excepting that relative to the sale or disposal of the tunnel to other parties. The Commissioners are also to have charge of the tunnel of the Troy & Greenfield road, and of all money received therefrom, or appropriated by the State. They will also have charge of the re-location of the Troy & Greenfield road, for which latter purpose the Legislature has appropriated \$1,500,000. But one day, the last of the session, was left to the Lower House to act on the bill, but it was considered certain that it would pass. So many conflicting opinions have been developed in the course of the discussion that this postponement seemed the only measure which had any chance whatever of passing.

NEW YORK CENTRAL & HUDSON RIVER CREDIT seems abundantly good. The proposals for \$1,000,000 of its 7 per cent. first-mortgage bonds, opened on the 30th ult., amounted to several millions, and the amount was awarded at prices which are on the average 105.34, only two bids under 105 having been accepted. This makes the average interest on the amount received about 6.65 per cent. It is a distinguishing feature of these dull times when "money is not to be had" that the choicest securities are more in demand and bear better prices than before the panic, which indicates that it is not money which is lacking to take up new bonds so much as confidence in their security. Another lesson to be drawn from this condition of things is that this is an exceptionally favorable time for companies with good credit to make new improvements. They can get the capital on better than the usual terms and the money will go very much further than for many years past. Companies which need steel rails and second tracks may not soon find so favorable an opportunity for getting them—that is if they are in good standing, as most companies which actually need such improvements are at this time.

THE CHICAGO, ROCK ISLAND & PACIFIC REPORT, an abstract of which we publish this week, shows a very healthy condition of things, the traffic having increased enormously (25 per cent. in freight), and the earnings nearly 10 per cent. The surplus above interests and expenses was sufficient for a dividend of 10 per cent. on all the stock outstanding, nearly one-sixth of which is in the possession of the company. No account is given of the earnings or expenses of the leased Chicago & Southwestern, whose interest the Rock Island pays by way of rental.

Comparison of Different Methods of Applying the Prismoidal Formula to Earthwork Computations.

BY ARTHUR M. WELLINGTON, C. E.

[From "Methods for the Computation from Diagrams of Preliminary and Final Estimates of Railway Earthwork, Giving Quantities to the nearest cubic yard on inspection, for both regular and irregular sections, direct from ordinary field notes." New York, D. Appleton & Co. (In press).]

This Appendix is added to compare the different methods of applying the prismoidal formula, FIRST, to the computation of three-level sections; and SECONDLY, to all forms of irregular sections in road-bed excavation; that is to say, earthwork with regular side-slopes.

The methods which may be used in computing three-level earthwork are:

1. The Method of par. 37—based on a direct determination of the dimensions of the mid-section by taking the half-sum of all the corresponding dimensions of the end-sections—the standard for all.
2. The Method of Level Sections; defined in paragraphs 35 and 39. The methods of "Roots and Squares," so-called, and those of Macneill, Baker, Trautwine, Lyon, Rice, and almost all other compilers of tables are simply this method in more or less modified forms.
3. The Method of Center-Heights—defined in par. 41—which consists in assuming the end-sections to be level sections of their actual center-heights, for the purpose only of determining a correction to be applied to the end-area solidity.

We will first compare the Method of Level Sections with a direct determination of the dimensions of the mid-section.

Taking any "three-level" prismoid, suppose the grade-prism, so called, formed by prolonging the side-slopes to an intersection below the road-bed, to be included in the solid. This is done partly to simplify the demonstration, and partly because it has been claimed, by a recent writer* that its introduction rectifies the error in the Method of Level Sections. It will be seen, however, that this is incorrect, and that its introduction or exclusion has no effect whatever on the comparative result.

Letting A and A' = the areas of the two end-sections; c_L and c'_L = the centre-height of level sections of equivalent area {always equal to $\sqrt{\frac{A}{r}}$ }, and D and c = the width on top and the centre-heights of the end-sections, we have—

$$A = \frac{Dc}{2} \quad A' = \frac{D'c'}{2}$$

* "Easy Rules for the Measurement of Earthworks," by Ellwood Morris, C. E., pp. 150, 153, 70, etc. A tabular example is given on page 152, to illustrate this supposed necessity, in which "the grade-prism is included in the earlier operations and excluded from the later ones;" but had the grade-prism been neglected altogether, the same results would have been reached, with much less labor.

It will be seen in the following pages that the above work contains some other errors in respect to accurate computation—notwithstanding its writer's deservedly high reputation as a civil engineer—which are pointed out as they come up, when connected with the present subject. The writer is induced to do this with some hesitation, because, as that work is recent and apparently exhaustive, its often quite erroneous statements may lead to fruitless labor; or, what is more likely, to a neglect of all more accurate methods than that of averaging end-areas.

$$c_L = \sqrt{\frac{Dc}{2r}}, \quad c_L = \sqrt{\frac{D'c'}{2r}}$$

Then by equation 17 we have, as the difference between the end-area solidity and the volume by the Method of Level Sections—

$$\begin{aligned} C_L &= (c_L - c'_L) \frac{1}{6} \\ &= \left\{ \sqrt{\frac{Dc}{2r}} - \sqrt{\frac{D'c'}{2r}} \right\} \frac{1}{6} \\ &= \left\{ \frac{Dc}{2r} + \frac{D'c'}{2r} - 2\sqrt{\frac{Dc}{2r} \frac{D'c'}{2r}} \right\} \frac{1}{6} \\ &= (Dc + D'c' - 2\sqrt{DD'cc'}) \frac{1}{12} \quad (a). \end{aligned}$$

We have now to determine the difference between the true volume and the end-area solidity. As given by equation 15, this difference, C , is—

$$\begin{aligned} C &= (c - c') (D - D') \frac{1}{12} \quad (b), \\ &= (Dc + D'c' - Dc') \frac{1}{12} \quad (c). \end{aligned}$$

The difference between these two differences is the error involved in the Method of Level Sections. Subtracting, then, equation (c) from equation (a), we have—

$$\begin{aligned} C_L - C &= (D'c + Dc' - 2\sqrt{DD'cc'}) \frac{1}{12} \\ &= (\sqrt{Dc} - \sqrt{D'c'})^2 \frac{1}{12} \quad (d). \end{aligned}$$

Equation (d) has always a positive value, since the square is always positive, and hence C_L is always greater than C . When, however, $\frac{c}{D} = \frac{c'}{D'}$, as is always the case when the surface-slopes in each section are identical, the equation reduces to zero.

It follows that the solidity by the Method of Level Sections is always too small, except when the surface of the ground is a plane. Equation (d) is evidently independent of road-bed and slope, since terms containing w and r have disappeared in deducing it, either in the above demonstration or in the paragraphs referred to.

Let us now consider the "Method of Center-Heights," defined in paragraph 41. The formula of correction by that method is the same as that of the Method of Level Sections, except that the actual center-height is used instead of reducing to an equivalent level center-height. Designating the correction by that method by C_H we have:

$$C_H = (c - c') \frac{1}{6} \quad (e).$$

By equation (b), the true correction is:

$$C = (c - c') (D - D') \frac{1}{12} \quad (f).$$

These two formulae become strictly identical only when, in two given sections, $(D - D') = 2r(c - c')$, which is only the case, except by accident, when the width of each section on top is equal to that due to a level section. For all ordinary surface-slopes, however, the difference is very small, as long as the surface of the ground is a plane, but $2r(c - c')$ is always less than $(D - D')$, causing a slight tendency to excess of solidity. When the ground is not a plane, the difference in width on top is sometimes greater than that due to level sections, and sometimes less, with no special tendency in either direction due to the irregularity of surface.

It follows that by the Method of Center-Heights the solidity will be sometimes too great and sometimes too small, with a slight tendency to excess.

The difference between these three methods is practically illustrated by the corrections obtained in paragraphs 43 and 45, for the two solids shown in figs. 9 and 12, and also by the tabular examples given below. In both instances the greater ultimate accuracy of the Method of Center-Heights, on account of its freedom from cumulative error, is very clear. A few numerical examples of course do not in themselves afford sufficient basis for a general statement, but it will be always sustained by a comparative trial of any extent.† By the aid of the Diagram of Prismoidal Correction such a trial can be made in an hour or two, on a mile or more of actual work. It is not necessary to determine and compare the actual volume of each solid by the three different methods, but the corrections only may be used for comparison, as shown in the tabular examples below.

If these conclusions are correct, it is difficult to account for the extensive use of the "Method of Level Sections," and its indorsement by continued new publications at the present day; but it is doubtless largely due to its convenience as the basis of a tabular method combined with its seeming precision; since there can be but one level section for a given center-height, while the Diagram of Cross-Sections gives 320. With one exception ‡ all the numerous compilers of tabular methods have used it in some of its various modifications; apparently following, without investigation, the example of Sir John Macneil—who invented, or at least introduced the method in the early days of railway construction—and of his numerous successors. The late Prof. Gillespie demonstrated its tendency to cumulative deficiency in the case of two level sections,§ but failed to point out any equally simple as well as accurate method, and his conclusions seem to have since been either ignored or explicitly denied.¶

One reason, perhaps, for the general use of the method is that, on any one given solid, it is nearly always more correct than the "Method of Center-Heights," and that any extended comparison involves so much labor by ordinary processes as to be out of the question. Doubtless such comparisons have been made between the methods of "Level Sections" and "Center-Heights" only, but the true volume is much more difficult to calculate, and the fact that it lies about midway be-

† It may be well to add that these remarks are based in part on such a comparison over the greater part of twenty miles of heavy work. By the methods here given, and by using corrections only for purposes of comparison, this was a very simple matter, and rapidly performed. In a total of about 400,000 cubic yards, the "Method of Center-Heights" gave an excess of a little over 400 yards, and the "Method of Level Sections" a deficiency of about 300. The error in the end-area solidity was about 6,000 yards.

‡ Warner's "New Theorems, Tables, and Diagrams, for the Computation of Earthwork." An exception should also be made of an ingenious and excellent system of unpublished tables, described by George B. Lake, C. E., in *Van Nostrand's Engineering Magazine*, vol. iv., p. 288, which is based on the Method of Center-Heights in a modified form, and there may be others unknown to the writer.

§ See *Journal of the Franklin Institute*, March 1859, and "Roads and Railroads," revised edition, p. 376.

¶ E. g., "Easy Rules for the Measurement of Earthworks," pp. 115, 150, 165, et al.

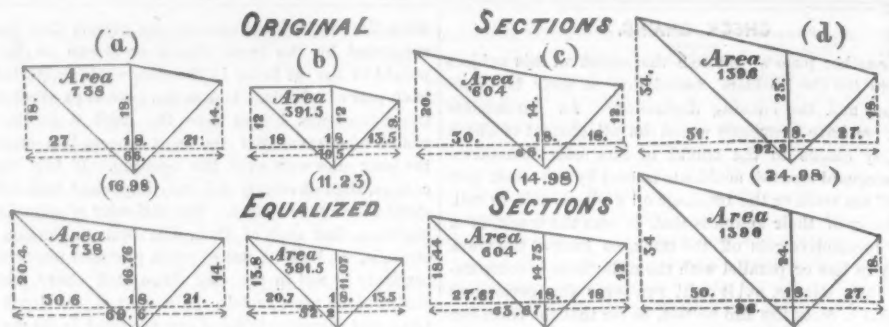


Fig. 28. The figures in brackets are equivalent level center-heights.

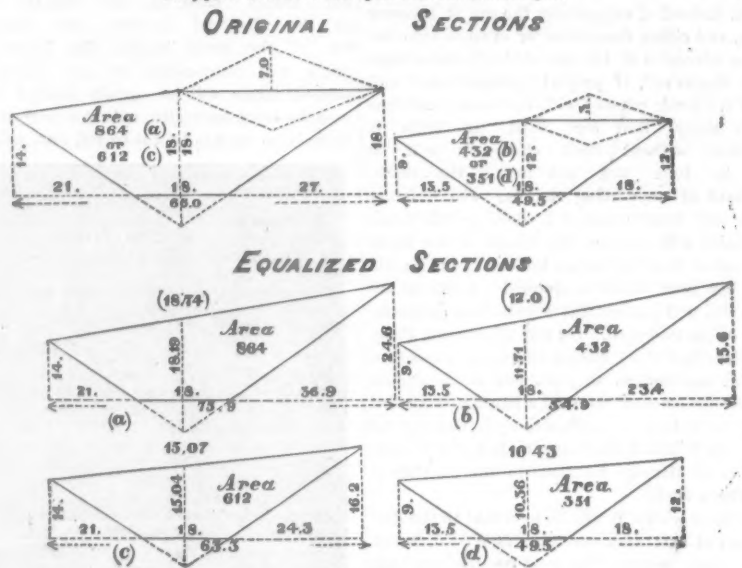


Fig. 29. The figures in brackets are equivalent level center-heights.

tween them can hardly have been determined. It is evident that, simply as a question of convenience, the "Method of Center-Heights" is much more simple and concise.

TO THE COMPUTATION OF IRREGULAR EARTHWORK all that has been said above as to the Method of Level Sections applies with equal force. The error always tends to deficiency, and is nearly always increased by the irregularity of the solid, though occasionally such irregularities counterbalance the tendency to deficiency. This remark is equally applicable to another still more elaborate process of computing irregular earthwork, which has been given at great length by a recent writer,* namely, to compute for each of the end-sections of an irregular solid a single equalizing line which shall inclose an exactly equal area, and then apply the prismoidal formula to the solid thus transformed. This process retains the same constant tendency to deficiency (in a slightly less degree) and is in detail as follows: After the area of the original section has been computed, the lowest side height is retained, and a new opposite side-height determined for a single uniform surface-slope, which shall include exactly the same area. Having determined the two side-heights, the solid may be computed by the formula of solidity for two-level prismoids, neglecting the center-height and width on top, or those dimensions may be determined from the side-heights and the solid computed by the formula for three-level sections. The two processes are not identical. In the first case the surface is assumed to be a single hyperbolic paraboloid, and in the latter to consist of two hyperbolic paraboloids, of which the centre surface-line and the two side-edges are directrices. The former process is not known to have been used for this purpose, but is both simpler and more correct than the latter.

We have, then, the following methods, any one of which may be used in computing irregular earthwork to compare with each other:

First. An exact computation, by computing the mid-section and applying the prismoidal formula directly.

Second. Computing the end-area solidity and determining a correction by the "Method of Center-Heights."

Third. Determining a similar correction by the "Method of Level Sections."

Fourth. Determining a similar correction by the formula for regular three-level sections, (eq. (b) above) neglecting the intermediate levels—as proposed in paragraph 56.

* "Easy Rules for the Measurement of Earthworks," by Ellwood Morris, C. E., pp. 31, 56, etc., and Chapters II. and III., *passim*.

** Two other methods are enumerated in "Easy Rules for the Measurement of Earthworks by the Prismoidal Formula," but neither of them are, strictly speaking, applications of the prismoidal formula. The first one, termed the "Method of Wedge and Prism" (page 123), is based on a subdivision of the solid as indicated by its name, and cannot be briefly described, as it consists of six distinct steps. The formula of error—for three level sections—is—

$$E = \frac{D-D'}{D+D'} \left\{ c'D - cD' \right\} \frac{1}{12}$$

This reduces to zero when the ground is a plane; otherwise it commonly has a considerable value. There is but one warped solid to which it applies correctly (one in which $D = D'$), and such a one is given as an illustration of the method (page 128 and fig. 30); but if the direction of each surface-slope in fig. 30 be reversed, and the center-heights made identical, the method will be in error 3,333 cubic feet. To both solids the Method of End-Areas applies correctly.

The second method, termed the "Method of Rhomboidal Wedge and Pyramid" (page 137) is merely a complex form of the Method of Level Sections, and consists in determining level sections equal to half the given areas, and then turning them bottom upward upon themselves, so as to form rhomboidal end-sections. Its error is measured by equation (d), and hence the numerical variations on page 142 are not due to insufficient decimals as surmised, but will be found to agree substantially with those given in the last table of this Appendix for the same solids. Of these facts, however, Mr. Morris does not seem to have been aware, since he describes this method as applicable, "however irregular the ground may be" (page 137); while the identical Method of Roots and Squares (equivalent to "Level Sections" is restricted to uniform surface-slopes, and to use as a test (pp. 109 and 117). It may be added that "Case 2" of this method (page 139), a modified rule for certain peculiar solids, is not of general application, and is only correct for the single illustrative solid given (fig. 82 and page 144). If the center height of the smaller section in fig. 82 be either increased or diminished by 10 feet, the solidity will be in error 20,000 cubic feet.

Fifth. Equalizing the sections by the process above given, and determining the prismoidal correction by equation (b), for three-level sections.

Sixth. Equalizing the sections and computing the correction from the side-heights only, by the formula for two-level sections.**

The latter formula has not been previously given, but is very similar in form to that for three-level sections, equation (b). Letting h, h' and p, p' be the side-heights of the end-sections—

$$C = (h - p) (h' - p') \frac{1}{6} \quad (f).$$

By comparing the formulae for each of these methods with each other, the following propositions with regard to them may be demonstrated mathematically; but the algebraic demonstrations are omitted, as they would necessarily be of considerable length, and the subject is not so important as to require it. They are sufficiently and more concisely proved by the numerical examples given below. These propositions are:

First. All methods of transformation by an equalizing line, whether it be level or otherwise, tend to diminish the apparent volume of the solid, unless every part of the original surface is a plane, and the surfaces of the end sections are "similar." In the latter case all the preceding methods except that of Center Heights give identical results.††

Second. The Method of Level Sections gives a smaller solidity than any other process.

Third. By reducing the end sections to a uniform surface slope, and regarding them as three-level sections, the error is nearly as great as in the Method of Level Sections (always slightly less), and tends always to deficiency.

Fourth. The solidity of "equalized" sections is always greater by the formula for two-level sections than by that for three-level, but the former is less accurate than the Method of Center-Heights.

Fifth. The fourth method above, i. e., that of neglecting the intermediate levels in determining the prismoidal correction, has no tendency to error in either direction, except that the ground is more frequently convex than concave.

The numerical examples referred to are given in the tables below. The first table applies to the sections shown in fig. 28, and shows the effect of the different methods on three-level solids. The second table shows the effect of adding intermediate levels to a solid which would otherwise be bounded by plane surfaces, and hence be given correctly by all the different methods except that of Center-Heights. The third table is a comparison of the three most prominent methods given above on eleven exceedingly irregular solids in Morris' "Easy Rules for the Measurement of Earthworks," and includes all such examples given in that volume.

Table of Comparative Results from Different Methods of Computing the Sections shown in Fig. 28.

Sections taken, in Fig. 28	PRISMOIDAL CORRECTIONS IN CUBIC FEET.					ERRORS IN CORRECTIONS.				
	True correction by prismoidal formula	By method of "center-heights"	By method of "level sections"	By method of "equalized sections"	By method of "three-level sections"	Method of "center-heights"	Method of "level sections"	Method of "equalized sections"	Method of "three-level sections"	From equalized sections
(a), (b)	56,475	825	900	825	825	-75	0	0	0	0
(c), (d)	67,300	0	400	100	100	-400	-100	-100	-100	-100
(a), (c)	106,200	1,569	1,225	1,600	1,593	+344	-31	-24	-24	-24
(b), (c)	49,875	275	100	351	350	+175	-76	-76	-76	-76
(b), (d)	88,375	4,702	4,225	4,763	4,737	+477	-61	-55	-55	-55
(c), (d)	99,600	2,466	3,025	2,506	2,501	-559	-40	-35	-35	-35
Net totals of errors in corrections						-36	-308	-200	-200	-200

Four sections of a very ordinary description are shown in this respect. Thus, on page 109 of "Easy Rules for the Measurement of Earthworks," it is limited "for exact work" to triangular end-sections with a uniform ground-slope.

Fig. 29, and the corresponding equalized sections given below. These four sections may be combined into the six different solids shown in the table, affording types of almost every possible variety of surface with three-level sections. The comparative accuracy of the Method of Center Heights is very clear; but the sections were in no way specially selected, and the same comparison will be found to always hold in a trial of sufficient extent. It will be observed that the Method of Level Sections is more nearly correct for each particular solid in every instance.

TABLE OF COMPARATIVE RESULTS FROM DIFFERENT METHODS OF COMPUTING THE VOLUMES OF IRREGULAR SOLIDS GIVEN IN MORRIS' "EARTHWORKS."	SOLIDITY.	PRISMATOIDAL CORRECTIONS "IN CUBIC FEET."				ERRORS IN CORRECTIONS.			
		By method of Par. 56, neglecting intermediate levels.	By method of level sections.	By method of centre-heights.	True correction.	By method of Par. 56, neglecting intermediate levels.	By method of level sections.	By method of centre-heights.	True correction.
as 2-level sect's.		1,136	1,136	1,136	1,136	0	0	0	0
as 3-level sect's.		1,136	1,136	1,136	1,136	0	0	0	0
Par. 56, neglecting intermediate levels.		1,136	1,136	1,136	1,136	0	0	0	0
Method of level sections.		1,136	1,136	1,136	1,136	0	0	0	0
Method of centre-heights.		1,136	1,136	1,136	1,136	0	0	0	0
By method of Par. 56, neglecting intermediate levels.		1,136	1,136	1,136	1,136	0	0	0	0
By method of level sections.		1,136	1,136	1,136	1,136	0	0	0	0
By method of centre-heights.		1,136	1,136	1,136	1,136	0	0	0	0
True correction.		1,136	1,136	1,136	1,136	0	0	0	0
By the prismatoidal formula.		1,136	1,136	1,136	1,136	0	0	0	0
By averaging end-areas.		1,136	1,136	1,136	1,136	0	0	0	0
Middle area.		1,136	1,136	1,136	1,136	0	0	0	0
Sections taken in Fig. 29.		1,136	1,136	1,136	1,136	0	0	0	0

The first solid (a) (b), in the first table, is bounded by plane surfaces, and hence is repeated in fig. 29 to show the effect of adding intermediate levels. Such an intermediate level, in any section, may evidently either increase or diminish its area; giving the new sections, (a), (c) and (b), (d). Then, for a given solid, these triangular areas may be either both additive giving the solid (a) (b); both subtractive (c) (d); the larger additive and the smaller subtractive, (a) (d); or vice versa, (c) (b). This affords types of all common cases with but one intermediate level, except that the larger triangle might have been on the smaller section in fig. 29, and vice versa. In that case, the column of errors in the Method of Level Sections would have been -35, -211, -182, -60, showing that the same law still holds in that case, and hence that the error tends invariably to deficiency in solids similar to fig. 29.

Table of Comparative Results from Different Methods of Computing the Volumes of Irregular Solids given in Morris' "Earthworks."

TABLE OF COMPARATIVE RESULTS FROM DIFFERENT METHODS OF COMPUTING THE VOLUMES OF IRREGULAR SOLIDS GIVEN IN MORRIS' "EARTHWORKS."	SOLIDITY.	PRISMATOIDAL CORRECTIONS "IN CUBIC FEET."				ERRORS IN CORRECTIONS.			
		By method of Par. 56, neglecting intermediate levels.	By method of level sections.	By method of centre-heights.	True correction.	By method of Par. 56, neglecting intermediate levels.	By method of level sections.	By method of centre-heights.	True correction.
as 2-level sect's.		1,136	1,136	1,136	1,136	0	0	0	0
as 3-level sect's.		1,136	1,136	1,136	1,136	0	0	0	0
Par. 56, neglecting intermediate levels.		1,136	1,136	1,136	1,136	0	0	0	0
Method of level sections.		1,136	1,136	1,136	1,136	0	0	0	0
Method of centre-heights.		1,136	1,136	1,136	1,136	0	0	0	0
By method of Par. 56, neglecting intermediate levels.		1,136	1,136	1,136	1,136	0	0	0	0
By method of level sections.		1,136	1,136	1,136	1,136	0	0	0	0
By method of centre-heights.		1,136	1,136	1,136	1,136	0	0	0	0
True correction.		1,136	1,136	1,136	1,136	0	0	0	0
By the prismatoidal formula.		1,136	1,136	1,136	1,136	0	0	0	0
By averaging end-areas.		1,136	1,136	1,136	1,136	0	0	0	0
Middle area.		1,136	1,136	1,136	1,136	0	0	0	0
Sections taken in Fig. 29.		1,136	1,136	1,136	1,136	0	0	0	0

The third table illustrates the effect of the above methods on solids which are exceedingly irregular, both as three-level sections and in respect to intermediate levels, and it will be seen that the tendency to deficiency in methods of transformation is not absolutely invariable, as might fairly be inferred from the two preceding tables. Without attempting an exact analysis of this question, it may be explained as follows: When the two end-sections are "similar," so that the solid is entirely bounded by plane surfaces, all methods except that of center-heights give identical results. When this condition is varied from in any way there is introduced a tendency to deficiency. In solids similar to figs. 28 and 29 this tendency is invariable. In more irregular solids, the same tendency exists, but other sources of error are introduced, with no tendency in either direction, which will occasionally equal or outweigh it. This may be proved by the same method as that used in fig. 29. Drawing any two dissimilar sections, and making the areas due to the intermediate levels first additive and then subtractive, the sum of the solids, obtained by a method of transformation, will always be in deficiency, and usually they will both be in deficiency. All this is sufficiently evident from an examination of the footings of the preceding table.

These remarks apply equally to the Method of Level Sections. The close similarity in these two methods, after the sections have been transformed, has led Mr. Morris to class them as identical "by Rules for the Measurement of Earthworks," page 56, though if they were so it is difficult to see the advantage proposed from the process of equalization. As will be seen above, however, such is not the case, and the slight discrepancies in the numerical examples on pages 56, 104, 106, etc. (always in one direction, it will be observed), are due to fundamental differences in the formulae, and not, as is there surmised, to insufficient decimals. But, as is shown above, the main error in that process lies in the transformation of sections into others of "exactly equal area."

tions and to the process of reducing sections to a uniform surface-slope, which give almost identical results; both tending always to deficiency, but the latter in a somewhat less degree than the former, owing to the fact that when the surface-slopes of the equalized sections are not precisely identical, equation (d) has a small positive value, as in the case of all other three-level sections.

It may be repeated here that this subject has not been discussed on account of the intrinsic importance of the discrepancies involved, but to show that the simplest methods, which seem merely approximate, are also more nearly correct than any process of transformation, although every step in the latter has an appearance of elaborate accuracy. Such needlessly tedious methods make the use of end-area solidities almost universal, but more accurate results may be reached with an inconsiderable amount of labor, which can hardly be an objection to the most indolent.

General Railroad News.

TRAFFIC AND EARNINGS.

—The earnings of the Grand Rapids, Newaygo & Lake Shore Railroad for the year 1873 were as follows:

Earnings (\$3,688 per mile)..... \$132,771

Expenses (\$2.37 per cent.)..... 69,532

Net earnings (\$1,767 per mile)..... \$63,239

—The earnings of the Philadelphia & Erie Railroad for May were:

Earnings (\$1,007 per mile)..... \$290,382 22

Expenses (77.31 per cent.)..... 224,493 15

Net earnings..... \$65,889 07

—The earnings of the Midland Railway of Canada for May were: 1874, \$32,216; 1873, \$36,936; decrease, \$4,720, or 12½ per cent.

—The shipments of through freight eastward over the Central Pacific Railroad for May were: San Francisco, 5,817 tons; interior points, 524 tons; total, 6,341 tons, or 634 car-loads. The principal items of freight were: wool, 4,147 tons; wine, 337 tons; salmon, 278 tons; tea, 209 tons. Wool thus formed 65.4 per cent. of the whole freight.

—The earnings of the Chicago, Milwaukee & St. Paul Railway for the third week in June were: 1874, \$199,000; 1873, \$216,604; decrease, \$23,604, or 10½ per cent.

—The earnings of the Michigan Central Railroad for the second week in June were: 1874, \$127,354; 1873, \$133,532; decrease, \$6,178, or 4½ per cent.

—The earnings of the Toledo, Wabash & Western Railway for the second week in June were: 1874, \$87,157; 1873, \$119,712; decrease, \$32,555, or 27½ per cent.

—The earnings of the St. Louis & Iron Mountain Railroad for the second week in June were: 1874, \$63,492; 1873, \$61,490; increase, \$2,002, or 3½ per cent.

—The shipments from the Lake Superior iron region from the commencement of the season up to June 25 were 225,949 tons iron ore and 11,408 tons pig iron.

—The total shipments of Lake Superior iron ore down to June 11 were 160,458 tons in 1874 against 140,590 for the same time in 1873, the increase being 14 per cent.

—The aggregate earnings of all the Russian railroads in 1873, averaging a length of 10,026 miles, was \$96,827,281, or \$9,656 per mile, against \$79,967,226 in 1872 from 8,724 miles, or \$9,166 per mile. The increase in earning per mile is 10.8 per cent. More than 28 per cent. of the earnings in 1874 were by one company—the Great Russian.

—The earnings of the Denver & Rio Grande Railway for the third week in June were: 1874, \$8,954; 1873, \$8,850; increase, \$104, or 1½ per cent.

CHICAGO RAILROAD NEWS.

Chicago & Pacific.

This company has secured 35 excursion cars and intends to make a special feature of carrying pic-nic parties and the like from Chicago to three pleasure grounds on its line—Turner Park, ten miles from the city; Franzen Park, 17 miles; and Roselle Park, 24 miles.

Chicago & Paducah.

The last rail was laid June 23 on the extension from Windsor, Ill., south by west to Altamont, the crossing of the Springfield & Illinois South-eastern and the St. Louis, Vandalia & Terre Haute. This new section of the road is thirty miles long, and the track on fifteen miles of it was laid last year. The whole length of the road is now 158 miles, from Streator in a generally southern direction to Altamont. Through cars will be run shortly from Chicago to the Ohio River at Shawneetown.

Chicago, Rock Island & Pacific.

In the suit of the city of Davenport against this company the Iowa Supreme Court has decided in favor of the city. The State railroad tax act of 1872 released all the railroad companies in the State from taxes levied before January 1, 1872. This the Supreme Court has decided is unconstitutional and void. The amount of back taxes involved is about \$30,000.

THE SCRAP HEAP.

Joliet Iron & Steel Company.

Under the new amendment to the bankruptcy laws a schedule of the creditors has been filed and the petitioning creditor has 20 days in which to secure the signature of the required number of creditors (one-fourth in number and one-third in amount) to the petition in bankruptcy. Should he fail to do so the proceedings will be discontinued. It is said that negotiations are in progress for a final settlement of the company's troubles.

Railroad Manufacturers.

The Indianapolis Rolling Mill, since January 1, has turned out 11,050 tons of new iron, having run constantly thus far this year, with the exception of a few days in February.

Messrs. Wick, Ridgeway & Co., of the Valley Mill at Youngstown, O., are making extensive improvements in their mill, and when completed expect to be able to turn out 1,000 tons of rails per week.

Messrs. Dawson & Bailey, at their National Locomotive Works, at Conneville, Pa., are turning out from four to six engines per month.

The erecting and painting shops belonging to the car works of John L. Gill, at Columbus, O., were recently burned.

OLD AND NEW ROADS.

Atlantic & Great Western.

At the special meeting held June 25, the stockholders voted unanimously to ratify the lease to the Erie.

The lease is for 99 years, dating from May 1, 1874, and includes all the road and property of the company, except rolling stock leased from other parties. The Erie is authorized to change the gauge of the Atlantic & Great Western at any

time, but is not under obligations to change the gauge. The rental to be paid is 28 per cent. of the gross earnings the first year, 29 per cent. the second year and 30 per cent. thereafter. The rental is to be paid monthly, for each month on the first day of the second ensuing month at such bank as the lessor may designate at any place in New York, Pennsylvania or Ohio. The lessor may appoint an agent who shall have free access to the lessee's books and accounts. The lease shall terminate if the rent remains unpaid for 60 days after it is due.

The Atlantic & Great Western guarantees the title to all the property and agrees, on notice, to take the necessary steps to acquire title to any property the Erie may desire to use in improving the road or relocating any portion of it. The usual provisions are made as to maintaining the property in good order.

It is provided that the provisions of this lease are not to apply to the lines of road constituting the Cleveland & Mahoning Valley Railway after the expiration of the several leases under which those lines are held. All leases and contracts are to be assigned to the Erie. The Atlantic & Great Western is to pay all rentals of leased lines and interest on bonds, but in case of default the Erie may pay them and deduct the amount from the rent. The Erie is to pay all taxes.

It is further agreed that the lease does not embrace the use of the Cincinnati, Hamilton & Dayton Railroad, nor any contract between the parties hereto relative to such use, but the contract between the parties hereto on that subject bearing date Nov. 9, 1871, and all other contracts between them in reference to such use are hereby abrogated and annulled; and it is further agreed that so long as the Erie Company shall do its business to and from Cincinnati and points beyond over said Cincinnati, Hamilton & Dayton Railroad the deficiency of the gross earnings thereby to meet the rental and charges required of it by its contract of April 28, 1869, and the modifications thereof since made, shall be borne by the parties hereto in the same proportion that the same now is, 52 per cent. by the Erie Company and 48 per cent. by the Atlantic Company; and if hereafter the Erie shall make any contract with the Cincinnati, Hamilton & Dayton reducing the rental, such reduction shall inure to the benefit of the parties hereto in the proportion above named.

The amount to be paid under this lease by the Erie, for labor supplies, etc., used on the Atlantic & Great Western since May 1, is \$800,000.

The percentage of the net to the gross earnings of the Atlantic & Great Western road, for the past eight years reported, has been (the year ending with September in every case):

Year.	Percentage.	Year.	Percentage.
1866.....	27.1	1870.....	17.5
1867.....	31.2	1871.....	14.5
1868.....	38.3	1872.....	15.7
1869.....	32.2	1873.....	32.6

During the whole period the gross earnings have been \$40, 320,288, and the net \$10,623,494, or 26½ per cent.

Central Vermont.

Since this company has come into possession of the Harlem Extension road, the old trouble with the Troy & Boston has been so far settled that running arrangements have been made with that road. Trains now run through from St. Albans, Vt., to Troy, N. Y., by way of the Harlem Extension to North Bennington, and then by Hoosic Junction, Eagle Bridge and the Troy & Boston. Sleeping cars by this line are run through from St. Albans to New York.

New York, New Haven & Hartford.

An examination of the accounts of Mr. Everett, Superintendent of Docks in New Haven, against whom the company was said to have brought charges of fraud, has shown that everything is correct. His books have been audited and found to balance.

Cincinnati Southern.

Work is progressing in Tennessee on the line south of Chitwood. On this section there are 13 tunnels, the longest being 2,250 feet.

Dividends.

Dividends have been declared by the following companies:

Boston & Lowell, 3½ per cent., semi-annual, payable July 1.

Old Colony, 3½ per cent., semi-annual, payable July 1.

Worcester & Nashua, 5 per cent., semi-annual, payable July 1.

Delaware, Lackawanna & Western, 2½ per cent., quarterly, payable July 20.

Illinois Central, 4 per cent., semi-annual, payable August 1.

Pacific of Missouri, 1½ per cent., quarterly, payable July 20.

Atlantic & Pacific Railroad Company, lessee.

Philadelphia & Reading, 2½ per cent., quarterly, payable July 24.

Concord & Portsmouth, 3½ per cent., semi-annual, payable July 1.

Albany & Susquehanna, Delaware & Hudson (anal Company lessee), 3½ per cent., semi-annual, payable July 1.

New York, Providence & Boston, 2½ per cent., quarterly, payable July 10.

Norwich & Worcester, 5 per cent., semi-annual, payable July 1.

Providence & Worcester, 5 per cent., semi-annual, payable July 1.

Portland, Saco & Portsmouth (Eastern Railroad Company lessee), 5 per cent., semi-annual, payable July 1.

Paterson & Hudson River and Paterson & Ramapo (Erie Railway Company lessee), each 4 per cent., semi-annual, payable July 2.

Fitchburg, 4 per cent., semi-annual, payable July 1.

Pittsfield & North Adams (Boston & Albany lessee), 2 per cent., semi-annual, payable July 1.

Berkshire (Housatonic Company lessee), 1½ per cent., quarterly, payable July 10.

Chicago, Iowa & Nebraska (Chicago & Northwestern, lessee), 4 per cent., semi-annual, payable July 1.

Iowa Falls & Sioux City (Illinois Central, lessee), 2 per cent., semi-annual, payable July 1.

Meetings.

The following companies will hold their annual meetings at the times and places given:

Erie, at the office, corner Eighth avenue and Twenty-third street, New York, July 14, from 10 a. m. to 2 p. m.

Eastern, of New Hampshire, in Portsmouth, N. H., July 14, at 10 a. m.

Portsmouth, Great Falls & Conway, in Portsmouth, N. H., July 14.

Gilbert Elevated Railway Company, in New York, July 7.

Burlington, Cedar Rapids & Minnesota.

This company has executed and is having recorded in Iowa a mortgage of \$2,000,000 to the Farmers' Loan and Trust Company, of New York, as trustee. This mortgage is a first lien on the surplus income and on a portion of the equipment, and a second lien on the rest of the property. It is dated June 18, 1874.

Pennsylvania.

The freight depot on Delaware avenue and Dock street, in Philadelphia, is nearly completed, and will be opened for business not later than August 1. The freight building is 472 feet long on Delaware avenue, with a width of 116 feet between Delaware avenue and Water street. The row of brick buildings on Walnut street, at the end of the depot, has been fitted

up for offices for the company's use. The roof of the depot is of the truss pattern, of iron, with a wooden chord, and will be slated. About half the trusses are already in position.

Two foundations are laid eighteen inches below high water level, on oak logs, embedded in concrete. While these were being laid the trenches were kept from water by means of the new vacuum pump, which performed its work very satisfactorily.

The tracks will run in the centre of the depot through the whole length, with transfer tables for shifting cars from one track to the other. The rails are laid on the east side of Delaware avenue, from Washington avenue to Lombard street, and the paving to nearly the same point. The rails are of steel, and very heavy, and so constructed that carts or wagons can easily pass them. As soon as this station is finished, the one at Thirteenth and Market streets will be abandoned.

Railroad Purchasing Agents' Association.

The first annual convention was held in Chicago, June 17. After an interesting meeting and the transaction of important business, the association adjourned to meet in St. Louis on the second Wednesday in May, 1875.

Eastern.

Parlor cars to run from Boston to North Conway, N. H., on the White Mountains, will be put on July 6.

Corpus Christi & Rio Grande.

A contracting firm has made a proposition to this company, offering to build the road in one year, provided the counties on the line will subscribe \$450,000 to the stock.

Cairo & St. Louis.

Flemings & Lacey, the contractors for the completion of the road, have a large force at work below Murphysboro, Ill., on the grading and on the tunnel. This is the only grading to be done, the rest of the line to Cairo being graded and requiring only the repair of the waste caused by the weather.

Worcester & Nashua.

The second track has been extended from Sterling Junction, Mass., to Clinton, making 17 miles of double track now in use, from Worcester to Clinton.

Grafton.

This railroad has been completed, and trains will commence running in a few days. It is three miles long, from Grafton Station on the Boston & Albany, 38 miles west of Boston, southward to Grafton Center.

New Bonds.

The bids for the \$1,000,000 new bonds of the New York Central & Hudson River Company amounted to several millions. The company accepted bids for \$1,000,000 at an average of 105.34, only two bids under 105 being taken.

For the New York & Harlem bonds advertised at the same time bids were received to the amount of several millions, but the award has not yet been made public.

North Shore, of Canada.

A sub-contract for 10 miles of the road from Pont Neuf, P. Q., to Jacques Cartier has been let to Joseph Trudel, of Quebec, who has already commenced work. This, it is said, is the beginning of a general resumption of work on the line.

New York & Oswego Midland.

An adjourned meeting of the first-mortgage bondholders is to be held at the Cooper Institute, New York, July 10, at 4 p. m. It is stated that important business will be brought before the meeting.

Paducah & Memphis.

In the case of Venable against this company the Tennessee Chancery Court has decided that no such corporation as the Paducah & Memphis Railroad Company is known to the law, the authority under which the charter was granted having been unconstitutional. This decision, if sustained by the Supreme Court, to which appeal will be taken, will invalidate all contracts made by the company.

Rome, Watertown & Ogdensburg.

It is reported that this company has secured control of the Syracuse Northern road, which runs from Syracuse north to Sandy Creek Junction, 45 miles. It has been to some extent a competitor with the Rome road for business. The Syracuse Northern has lately been in somewhat embarrassed circumstances.

Delaware, Lackawanna & Western—Morris & Essex Division.

On the new tunnel through Bergen Hill the last heading has been driven about 90 feet in. The workmen have passed through the shale and disintegrated rock and are now working in hard trap rock. The debris from this heading is used in filling up on the eastern approach, which already begins to make considerable show. Work has also been commenced on the trestle across the meadows for the western approach.

Work on the building of new coal dumps, the removal of some of the old ones and other alterations in the Hoboken yard is progressing steadily and everything will be in readiness by the end of the season for the new passenger depot which is to be built next year.

Allegheny Valley.

An adjourned meeting of creditors was held in Pittsburgh, June 30, to receive the report of the committee appointed to confer with the Pennsylvania Railroad Company. The proposition made by that company is that the Allegheny Valley make a 7 per cent. income bond, the issue limited to \$6,500,000, secured by a trust deed covering all income except enough to pay operating expenses, and interest on the existing bonded debt. Of the bonds so issued \$3,500,000 shall be issued at par to pay all floating-debt creditors except the Pennsylvania and Philadelphia & Erie companies. The Pennsylvania Railroad Company will then agree to make a traffic contract and to receive these bonds at par in payment of 10 per cent. of all freight on traffic passing over the line to and from the Allegheny Valley.

It is stated that the creditors generally are not satisfied with this proposal. The committee recommends the enforcement of payment in all possible ways unless immediate provision is made for the payment of claims.

The Texas Aid Bonds to the International.

A despatch from Austin, Texas, July 1, says, with regard to the hearing of the case involving the obligations of the State of Texas to issue its bonds to the International Company: "Case taken up yesterday, argument will be finished to-day and decision probably within a week."

It will be remembered that on the recent trial before the Supreme Court of Texas, the four judges were equally divided (there being a question of the jurisdiction of the Court as well as of the validity of the legislation). This made it necessary to add a judge to the bench, before which the case is now being heard.

The Wisconsin Railroad Law.

The suits of the Chicago & Northwestern Company against the Railroad Commissioners was to come up in the United States Circuit Court at Madison, Wis., July 1. Judge Davis of the Supreme Court will sit with Judge Drummond, the Circuit Judge, at the trial of these cases.

In the suits against the Chicago & Northwestern and Milwaukee & St. Paul Companies for forfeiture of charter, a postponement for ten days has been had.

Much excitement was caused by the statement that the West Wisconsin Railroad Company had ceased to stop its trains at Hammond, one of its conductors having been arrested in that village for violating the law. The conductor was acquitted, and the threat was not carried out. This incident seems to have caused much bad feeling, and threats of burning bridges and tearing up the track were made in local papers.

West Wisconsin.

In the suit of this company against the Supervisors of Trempealeau County, Wis., the Supreme Court on appeal has affirmed the judgment of the Circuit, and decided that the company's land grant was liable to taxation.

Rochester, Nunda & Pennsylvania.

Rochester (N. Y.) state that dispatches have been received there announcing that the agents of this company had succeeded in selling a considerable amount of its bonds in Europe at 70, gold.

Illinois & St. Louis Bridge.

The last stone has been laid in the tunnel on the Western approach. All but four of the iron girders carrying the tunnel roof in front of the St. Louis post-office are in position. The track is laid in the tunnel from the bridge to Seventh street, and from Poplar to Olive street. The tunnel was to be ready for the passage of trains by July 4.

Kansas Pacific.

Notice is given to bondholders that the company will apply to the District Court of Wyandotte County, Kansas, at its next term to have Matthew Baird, of Philadelphia, appointed trustee in place of J. Edgar Thomson, deceased, under the several mortgages in which Mr. Thomson was a trustee.

Tennessee & Ocoosa Rivers.

Books of subscription to the stock of this company are to be opened in Tusculum, Ala., July 16.

Frankfort & Kokomo.

The contractors, Messrs. Adams & Wells, who own the road, completed the laying of track May 27 and have since been running construction trains and some excursion trains. The road is now about one-third ballasted and the work of ballasting will soon be completed, when regular passenger and freight trains will be put on. The road is 25½ miles long, from Frankfort, Ind., northeast to Kokomo, and connects the Logansport, Crawfordsville & Southwestern at Frankfort with the Indiana, Peru & Chicago and the Pittsburgh, Cincinnati & St. Louis Chicago line at Kokomo. It is expected to have a considerable traffic in coal, besides other freights.

Duck River Narrow-Gauge.

A correspondent informs us that work on this road is now fully under way, about two miles of the line near Columbia, Tenn., is graded and a large force is driving the work through. It is intended to run on the Nashville & Decatur for 1½ miles out of Columbia, a third rail being laid.

Milwaukee & Superior.

J. R. Bingham, Receiver of this company, having asked the United States Circuit Court to restrain certain parties from interfering with him as Receiver, the Court dismissed the bill, on the ground that it was defective in not naming the company as a defendant with the other parties.

St. Louis, Lawrence & Western.

Kansas papers report that negotiations are on foot for a lease of this road to the Kansas Pacific. The road is 93 miles long, from Carbondale, Kan., eastward through Lawrence to the Missouri Pacific at Pleasant Hill, Mo.

Louisville, New Albany & St. Louis.

It is reported that this company has made arrangements with parties in Philadelphia for the money necessary to complete the road from New Albany, Ind., to the St. Louis & Southeastern at Mount Vernon, Ill.

New York Central & Hudson River.

The suit of this company against the collector of internal revenue to recover taxes alleged to have been wrongfully collected as taxes on the stock dividend of December, 1869, came up in the United States Circuit Court at Canandaigua, N. Y., June 25. After hearing the opening arguments the Court adjourned over to July 1.

The company claims that the tax was wrongfully assessed, and further that the property of the present consolidated company was not liable for a tax assessed against the New York Central Railroad Company.

New Orleans, Mobile & Texas.

Proceedings in bankruptcy have been commenced against this company in the United States District Court at New Orleans, and an order has been granted requiring the company to appear November 16, 1874, and show cause why it should not be adjudged a bankrupt.

Western North Carolina.

The foreclosure sale of this road has been postponed for two months, and will take place in August.

Kent County.

The difficulty with the employees has been adjusted, and trains commenced running again June 25, after a stoppage of several days. It appears that when the present management took possession about four months' pay was due the men, and they demanded their back pay besides security for future payment. The management finally compromised by giving the men one month's pay and security for the payment of their wages hereafter.

Frankford & Breakwater.

Track is laid half a mile beyond Millsboro, Del., and 10½ miles south from the junction at Georgetown with the Junction & Breakwater road. About five miles of track remains to be laid to complete the road to Frankford.

Pennsylvania Petroleum.

A party of Englishmen who are interested in the Atlantic & Great Western have been in Titusville, Pa., and along the line of this road. It is reported that work will be resumed on the section from Titusville to the Atlantic & Great Western at Cambridge and that portion of the road completed this year.

Wilmington & Reading.

Coal from the Lehigh Valley has already commenced coming over the Berks County road and the above road to Wilmington.

It is proposed to build a branch about five miles long from Seed's Bridge on this road to West Chester, Pa.

Belfast & Moosehead Lake.

The Maine Supreme Court has decided against this company in a suit brought against the town of Unity to recover \$30,000 subscribed to the stock of the company. The town had by the required two-thirds vote agreed to take this amount of stock, but before the road had accepted the vote, and before the line was located, the town by a majority vote rescinded its previous action. The court decided that a majority can reverse action taken by a two-thirds vote.

St. Louis & Southeastern.

Proceedings have been commenced at Henderson, Ky., by Joseph Horner to have a receiver appointed for the Nashville Division (Henderson to Nashville). It appears that Horner

recovered judgment against the company for \$5,000 for injury received by an accident, but was unable to collect. A bill was then filed by Horner in equity, making the bondholders of the Evansville, Henderson & Nashville Railroad and also the St. Louis & Southeastern Railway (consolidated) parties to the suit. The bill asks that the interest on bonds not paid be settled by a receiver and the judgment of Horner be satisfied. It is said that holders of about \$180,000 of bonds have joined in the petition.

The company announces that the coupons of the Evansville, Henderson & Nashville bonds due July 1 will be paid September 1.

St. Paul & Pacific.

In the Court of Common Pleas at St. Paul, Minn., De Graff & Co., contractors, have brought suit to recover some \$670,000 for work done on the Brainerd Branch, besides another large claim for work on the St. Vincent Extension. Besides the company Mr. J. P. Farley, Receiver for the St. Vincent Extension, and the trustees under the mortgage are made parties to the suit. In the District Court a large number of small suits have been commenced to recover for work and labor done.

Boston, Concord & Montreal.

This company is now running through trains from Boston to Montreal, passing over its own line from Concord to Wells River, the Connecticut & Passumpsic Rivers road to Newport, and the Southeastern Railway from Newport. Two through trains are run daily.

Pittsburgh, Wheeling & Kentucky.

Ohio County, W. Va., is to hold an election July 21, to decide whether the county will subscribe the sum of \$300,000 to complete the road, in which it has already invested \$240,000. Brooke County agrees to guarantee the interest on \$60,000 of the bonds.

Bowling Green & Toledo.

A company has been organized to build a railroad from Bowling Green, O., west by north to the Dayton & Michigan at Tontogany or Hastings, a distance of about eight miles.

Monticello & Port Jervis.

The necessary papers have been filed in the Clerk's office of Orange County, N. Y., for the commencement of a suit for the foreclosure of the first mortgage on this road.

Winona & St. Peter.

Officers of this company have been over the unused portion of the line west of Marshall, Minn. It was found in fair condition, but the weeds had grown so thick upon the track that it at times seriously impeded the progress of the train. At the Minnesota State line there is a small settlement, and occasionally trains will be run that far during the season.

Atchison, Topeka & Santa Fe.

The Cimarron (New Mexico) News says that the surveying party of this company has discovered a new crossing of the Raton Mountains east of Trinidad, which gives a better, shorter and cheaper line than any route heretofore reported.

Erie.

Mr. Dunan, the late Auditor, has written a letter with reference to the recent resolutions of the board of directors. Mr. Dunan states that a fair judicial investigation of the charges made by him against the officers of the company is all he desires, and he hopes that immediate action may be taken to procure such an investigation.

Messrs. Little, of the Northern Central, and Houston, of the New York & Oswego Midland, who have been examining the books, report that Mr. Dunan overstated the floating debt by \$3,000,000.

At the directors' monthly meeting, June 25, the Treasurer reported the total amount of floating debt \$2,431,971.63, a decrease of about \$197,000 during the month.

Illinois Railroad Aid Bonds.

The amount of the bonds issued by municipalities under the Illinois railroad aid law, recently declared unconstitutional so far as it shifts from the municipalities the burden of their State taxes, was \$13,501,051.58 at the close of 1873. There were then also nearly \$2,000,000 of bonds outstanding registered under the act of 1865.

Virginia & North Carolina.

The contractor for this road, Mr. Sidney G. Miller, of New York, has commenced work on the road at Elizabeth City, N. C., and will soon have a considerable force employed. The contract requires the road to be completed within a year. It is to extend from Norfolk, Va., south to Elizabeth City, N. C., about 50 miles. It is intended hereafter to extend it from Elizabeth City southwest to Edenton and Plymouth.

New York & Eastern.

The Railroad Committee of the Connecticut Legislature has resolved to make an adverse report on the petition of this company for leave to bridge the Housatonic River. The report is based mainly on the fact that the means provided by the company are altogether out of proportion to the probable cost of the road, and the evidence collected tends to show that the company was organized mainly for speculative purposes.

New York & New England.

It is stated that the Berdell bondholders have not yet subscribed the \$500,000 necessary to obtain the loan of \$250,000 authorized by the State of Massachusetts. In case the amount needed before the property can be transferred to the new company is not made up, it is probable that the holders of the trustees' certificates of indebtedness will take steps to realize on their claims. In this case there will be further litigation, and the transfer of the road will be further postponed.

St. Joseph & Denver City.

In the United States Circuit Court at Leavenworth, Kan., June 10, in the foreclosure suit against this company, an order was made appointing W. M. Grant, of Davenport, Ia., a special master for the purpose of ascertaining and reporting to the Court the amount of interest due and unpaid upon the bonds of the Eastern Division, and also the amount of bonds issued and secured by the mortgage of that division. In order to enable the Master to make his report, it is necessary to give proof of the amount of interest due, and bondholders are requested to deposit their bonds and unpaid coupons with the Farmers' Loan and Trust Company, in New York. Holders of bonds not so deposited will have to present them to the Master at Davenport, Ia. A form of agreement for a reorganization, the general features of which have already been approved by a large majority, will be presented to the bondholders. This order applies also to the Western Division bonds.

A special term of the Circuit Court will be held at Leavenworth, August 24, for the purpose of entering a final decree of foreclosure against the Eastern Division and so much of the Western Division as is in Kansas.

It is thought that arrangements for the reorganization will be effected this week.

Wisconsin Railroad Law.

Nothing new has been done in the way of enforcing this law against the protesting companies, although the arrests and trials of the conductors and station agents continue, and there are many minor and vexatious contests between railroad men and travelers or shippers of freight. It seems as if there was

no prospect of a stop being put to this state of affairs until a decision is reached in one of the test suits the Chicago & Northwestern Company has brought in the United States Courts.

Syracuse & Northern.

A meeting of the stockholders was held in Syracuse, N. Y., June 16, to consider the condition of the company. From the statements submitted it appears that for the year ending June 1, the net earnings were \$42,011.30, out of which interest on \$500,000 first-mortgage bonds was to be paid. Interest on \$400,000 second, and \$200,000 third-mortgage bonds (issued mainly to provide for floating debt) has not been paid for a year, and a foreclosure is threatened. There is also due the Syracuse & Chenango Company one-half the cost of the connecting line through Syracuse. After a long discussion it was resolved that so much of the \$200,000 of the third-mortgage bonds still unissued as may be needed shall be issued in payment of the past-due interest, and that creditors be requested to fund their interest in those bonds.

Huron & Ontario Ship Canal.

This company, which purposes carrying out the old project of a ship canal from Georgian Bay to Toronto, has lately been reorganized, has secured considerable subscriptions to its stock and is trying to secure a grant from the Dominion of Canada. It is claimed that the distance is only 100 miles, of which only 40 would be canal, the remainder slack-water and lake navigation.

Chesapeake & Ohio Canal.

At the regular monthly meeting of the directors in Annapolis, Md., June 16, the President reported a balance on hand, after paying May expenses, of \$84,949.01. The board ordered the payment of the coupon maturing July, 1880, on the preferred construction bonds and appropriated \$50,988.50 for that purpose.

Bingham Canon.

The grading is very nearly completed and the rails have been purchased for an extension of three miles from the present terminus at Bingham Station to the Utah Mining Company's works. This extension runs up the side of the canon, being in a side-hill cut nearly all the way, and rises 600 feet in the three miles, having a nearly uniform grade of 200 feet to the mile.

Ashtabula, Youngstown & Pittsburgh.

At the annual meeting in Ashtabula, O., June 10, the stockholders passed a vote of thanks to Mr. Wm. McCreery, who declined a re-election as President, for his earnest and successful efforts in the interest of the road. It was then resolved to issue \$500,000 second mortgage bonds, payable in the year 1904 and bearing 7 per cent. interest.

Knoxville & Kentucky.

The Tennessee Circuit Court has decided that \$100,000 of bonds issued by Anderson County, Tenn., to this road were illegally issued and are void.

St. Louis & River des Peres.

This newly-organized company purposes building a railroad from a point on the west bank of the Mississippi, near the mouth of the River des Peres, following the course of the river to a point near the Gravois road, thence north to Tower Grove Park and into St. Louis to form a junction with other roads at Union depot. The road will be 12½ miles long and the capital stock is to be \$250,000. The principal office is in St. Louis.

Flemington, Trenton & Tuckerton.

It is proposed to build a railroad from Flemington, N. J., south to Trenton and thence southwest to Whiting's Junction, where connection would be made with the New Jersey Southern and Tuckerton roads. The project comprises an extension of the Tuckerton road from Tuckerton four miles to Great Bay and the establishment of a coal shipping port at that point.

Buenos Ayres & Campana.

This company has recently marketed its shares in London for the construction of its railroad from the city of Buenos Ayres to the port of Campana on the Parana River, a distance of 50 miles, with wharves and bonded warehouses on a large scale. Mr. Neville B. Smith, C. E., of Buenos Ayres, is Chief Resident Engineer and General Manager, and Edwin Clark, Purchaser & Co. contractors. The cost is estimated at about \$80,000 per mile. Work was begun on the grading nearly two years ago, and the materials for completing the road have been shipped.

San Francisco & North Pacific.

The shops at Dopahue, Cal., which were burned some time since, have been completely rebuilt and are now in use. There is a machine shop 50 by 120 feet, a car-shop, 45 by 160 feet, and a round-house holding seven engines. The shops are well supplied with tools, and arrangements have been made for a full supply of water in case of another fire.

St. Francis & Megantic International.

English journals of June 13 had an advertisement offering \$100,000 of a total issue of \$375,000 of 7 per cent. first-mortgage bonds of this company at 87½, the object of which is the completion of the first 30 miles of the company's railroad, from Sherbrooke, Province of Quebec, on the Grand Trunk Railway, 101 miles east of Montreal, eastward to Bury. The line is to extend 50 miles further, to the Maine border, where it is expected to meet a projected road in that State which will connect it with the Intercolonial Railroad, shortening the route from Montreal to St. John and Halifax by 154 miles. The company has stock subscriptions to the amount of \$283,000 from the country along the 30 miles now to be constructed, which it is intended to complete in September next, and it has a land grant of 752,000 acres of timber land from the Province, situated in the St. Maurice territory.

Flushing & North Side.

It is proposed to consolidate the Flushing & North Side, Central of Long Island, Central Extension, Whitestone & Westchester, North Shore and Roslyn & Huntington companies, which would bring all the railroad lines on Long Island outside of the Long Island and South Side systems under one management.

Grand Rapids & East Saginaw.

Five miles of the line from Maple Rapids, Mich., eastward are graded and 15 miles cleared. Contracts for the road ready for the iron have been let for an average price of \$6,400 per mile, 80 per cent in cash, the balance in bonds at par.

Montclair.

The running of trains from Montclair to Jersey City has been prevented by Mr. Pratt's injunction for some time past, and now the operation of the upper end of the road, from Montclair to Monk's, has been stopped by Mr. Clark, of Westburg. Mr. Clark permitted the company to occupy a portion of his land under a contract to run trains regularly to New York, and the company having failed to comply with that contract, he has resumed possession of the land, taken up the rails and carried his fences across the road-bed.

Delaware River & Bound Brook.

This company, whose road is to follow very nearly the line laid out for the National Railway, and which is practically the successor of that dormant organization, is said to be securing

and paying for the right of way. Much trouble has been had with the farmers, who sold the right of way to the National and were paid only in promises, or at best in stock, which is now worthless. The new corporation is paying cash, and in some cases, where the line is the same, it has given cash for the old National stock. The line is not yet fully determined on, the point of doubt being the crossing of the Delaware, which may possibly be made near Bricksburg, 11 miles above Trenton. This will probably depend on the route adopted in Pennsylvania. From near Pennington, N. J., to Bound Brook the line, it is said, is finally located.

The prominent men in the new company are all connected with the North Pennsylvania Railroad Company, which has long desired to secure a route to New York. The Pennsylvania section of the line will be a branch of that road. The new company appears to be showing pretty vigorous signs of life and it is possible that the competing line from New York to Philadelphia will be built after all. The intended use of the New Jersey Central from Bound Brook to Jersey City will avoid all trouble in securing terminal facilities at the latter place.

Portland & Rochester.

At a special meeting of the City Council of Portland, Me., held June 23, the Finance Committee reported that the Portland & Rochester Company could not meet the July interest on its bonds and provide the equipment required by the contract, and necessary to transact business coming from the Nashua & Rochester road, by September 1. The amount of interest due is \$34,500. The Board of Aldermen resolved to authorize the borrowing of that amount by the city, to be charged to the account of the road, but the Common Council failed to concur. Portland has invested \$1,150,000 in the road.

New Jersey Midland.

At a recent meeting of the directors it was voted to abolish the recently created office of Managing Director. Mr. D. C. Littlejohn, who held the position, consequently retires.

The milk business is steadily increasing, and the milk train is said to be the most profitable on the road, its earnings averaging \$700 per day. The average load is now about 1,200 cans, which hold from 40 to 60 quarts each. The milk comes mainly from the upper end of the road in Sussex County, N. J., and Orange County, N. Y.

Indianapolis & Western.

This company has been organized at Indianapolis, Ind., to build a railroad from that city nearly due west to Montezuma, the present eastern terminus of the Indiana & Illinois Central. The road will be about 67 miles long and the capital stock is to be \$2,000,000. Surveys are to be commenced very soon.

Vermont & Canada.

A special meeting of the stockholders will be held in Bellows Falls, Vt., July 8, at 12 noon, to vote on the agreement for the sale of the road to the Central Vermont Company.

Chicago & Alton.

This company has appealed to the Supreme Court of the United States from the decision of the Circuit Court declining to take jurisdiction in the suits against the company.

Mississippi Valley & Western.

The report that this company was to be consolidated with the Quincy, Alton & St. Louis is denied.

Cairo & Vincennes.

A motion to dissolve the injunction against the company and to discharge the receivers was argued in the United States Circuit Court at Springfield, Ill., June 23. The attorney for Messrs. Winslow & Wilson, the contractors, offered to submit documents showing a private contract by which the President of the company and other parties were to receive shares of the profits of the contract, but the Court declined to admit them.

The motion of the company for the dissolution of the injunction and dismissal of the receivers was finally denied by the Court after a full hearing. The receivers consequently remain in possession.

Allegheny Valley.

The committee appointed at the recent meeting of creditors of this company reports that a conference has been had with the officers of the Pennsylvania Railroad Company, and that that company is not willing to endorse the bonds in which the Allegheny Valley Company proposes to fund its floating debt.

The following is the general statement of the floating debt as presented to the creditors:

Bills payable.....	\$1,964,908 15
Accounts payable.....	589,329 43
Due Pennsylvania Railroad Company.....	1,310,891 11
Due contractors and others.....	557,143 44
Bonds and mortgages on railroads, estimated.....	144,193 97
Sundries and individual accounts.....	465,985 19
Due railroad companies in current accounts.....	25,567 15
Coupons of Bennett's Branch bonds.....	2,895 00
Interest due State of Pennsylvania.....	87,506 00
Interest due July 1 on first-mortgage bonds.....	145,000 00
Taxes due the State, estimated.....	34,900 00
Interest on purchase of Oil Creek Stock.....	61,500 00
Total.....	\$5,338,016 44
Contra.	
Cash on hand.....	\$44,365 63
Sundry accounts.....	230,393 01
May earnings uncollected.....	14,101 35
263 Bennett's Branch bonds, endorsed by Pennsylvania Railroad Company at 90.....	235,800 00
Total.....	\$514,659 99
Balance.....	\$4,823,356 45
Add cost of 41 shares of Oil Creek & Allegheny River stock.....	1,537,500 00
Total floating debt.....	\$6,360,856 45

This floating debt is mainly the result of large expenditures for equipment and improvement of the main line and construction of the Eastern Extension.

The Grand Trunk Proposals for Locomotives.

The Paterson (N. J.) Press has the following article, the facts for which doubtless were furnished by a well-known locomotive builder of that city:

"We are very sorry to have to announce that the order for 50 locomotives for the Grand Trunk Railway of Canada, bids for which were advertised for a short time since, and of which high hopes were entertained that the work might be secured for one of our Paterson shops, has gone to a New England establishment, which was able to bid on a lower basis of labor than our locomotive builders ventured to hold. Our Paterson builders made strenuous efforts to secure this order, not because they expected to make any money out of it, but simply to open their shops, employ their machinery and put their operatives at work. We know as a positive fact that the locomotive companies of Paterson (and of all other places, too), expecting sharp competition, shaved their figures down to the lowest that they dared venture, and the close agreement among the most of them shows how closely the thing was figured down. The bids received were as follows:

Rogers Locomotive & Machine Co., of Paterson.....	\$10,260
Danforth Locomotive & Machine Co., ".....	10,060
Baldwin Locomotive Works, of Philadelphia.....	10,575
Schenectady Locomotive Works.....	10,500

Pittsburg Locomotive Works.....	10,850
Kington (Canada) Locomotive Works (sold).....	10,900
Portland Locomotive Works.....	10,000
Hinkley (Boston) Locomotive Works.....	14,510
Manchester Locomotive Works.....	9,250
Rhode Island Locomotive Works.....	8,900

"The bid of the Rhode Island (Providence) Works was much the lowest, and, of course, the contract was awarded them. This company have put their figures so low that all their competitors agree that they must lose money. They underbid even the Manchester (N. H.) Works, who had 20 locomotives in process of construction which they expected to sell to the road. We understand that the figuring between these two shops was a regular 'cut throat' game. Not one of the other builders whose bids are given could see any object whatever in taking the order at less than \$10,000 an engine, and most of them came away from the opening of the bids pleased that their offer was not accepted, as all of them had made their estimates to cover the bare cost, without a dollar of interest on the investment. Added to this is the fact that the conditions of the contract were very exacting, failure to deliver to the day, or any defect in construction or material entailing heavy damages.

"From the above statement, which our readers may depend upon is true in every particular, our citizens and mechanics may understand the difficulties which lie in the way of our locomotive establishments—the great source of our prosperity, and really the mainstay of our city getting started again. The main trouble is the labor question. Our mechanics, hard as the lesson is to learn, must make up their minds to face one of two inevitable alternatives: wages will have to be lower, or there will be no work. It is literally the choice, so far as locomotive building is concerned, of 'half a loaf or no bread,' employers and employed agreeing to share the loss between them. When our locomotive builders in good faith make an earnest and determined effort to get a contract, figured for at the actual cost of doing the work, and are underbid by other places, it is clear that the employers have gone as far as they can be expected to go. It is time now for the men to inquire what they can do to relieve this miserable 'dead-lock.'"

It will be seen that there were four locomotive shops which put in no bids, the Taunton Locomotive Works, the Mason Works, the Dickson Company at Scranton and the Grant Locomotive Works. The latter, with their Russian order, probably have work enough to keep them going for some months yet, and are better off than most of the other shops.

Truck and Car Body Check-Chains.

At the recent convention of the Master Car-Builders' Association, the committee on this subject made a report, which was read by the Secretary, as follows:

REPORT.

To the Master Car-Builders' Association:

GENTLEMEN—Your Committee on Truck and Car Body Check-Chains respectfully report that about 350 copies of interrogatories were issued by us in the form of a circular. Twenty-five replies were received, a large proportion of which were from persons who are not members of the Association.

[The Committee give the replies to the various questions in detail, and conclude as follows:]

In giving a statement of the answers received, your Committee have endeavored to give the substance of them as nearly as practicable, without using the precise language of each individual. From these answers, it will be seen that a majority of those who favor us with their opinions are in favor of the use of check-chains, and a part of those who are not so decidedly in favor of their use are of opinion that they would be desirable if they could be so constructed as to avoid the weak points that are so apparent in a large proportion of the chains and fastenings as now applied.

Your Committee would like very much to give the views of several of those who have written in full upon the subject, but space will not permit; we will therefore briefly point out some of the defects in the application of the chains and fastenings, etc., and also make some suggestions looking toward an improvement.

Check-chains, as usually applied, with eye-bolts through the truck sides and sill of car, are defective from being so placed that the full strength of the timber is not available, as the strain is down and sideways on the sill, and usually tears out the lower portion of it, leaving the upper part in place, and with the truck vice versa. Where hook or eye-plates are bolted to truck side and sill, the strain bears on the bolt nearest to the hook or eye, and the result is, that either the bolts or timber break and give way in detail, and in cases where lag or wood screws are used, the result is the same.

In order to have check-chains of value, they should be of such proportion that their strength will be equal to the resistance of the timbers to which they are attached, and the fastenings to the timber should be so constructed that the full strength of the timber would be utilized. The point of attaching chains to truck and car-body respectively should be such that the chains would be at right angles to the body of the car when the chains are drawn taut, and the length of chain sufficient to admit of running the shortest curves with safety.

Your Committee think that it is not necessary to dwell on the size of iron or length of links in check-chains, and will pass to the matter of their attachment to the car-body. There are different methods of attachment to the sill or a special timber, so that the full strength of the timber can be made available. One method which your committee would recommend is to place an iron plate of suitable size and strength on the inside of the sill with an angle turned over, and extending half across the top of the sill, and an eye to receive a ring at the lower end of the plate near the lower inside corner of sill; also a similar plate on the opposite side, with an angle extending half across the top and another angle at the lower outside corner, the plate extending across the bottom of sill to near the inside corner, with an eye to receive the ring above referred to; then by bolting through the plates and sill, and the ends of the plates being drawn together by the ring passing through the eye near the ends, the sill or timber is securely inclosed, and with the irons properly proportioned, its strength is fully utilized. Without occupying further time your Committee would recommend the adoption of the following resolution:

Resolved, That truck and car-body check-chains are, when properly applied, a valuable acquisition on passenger equipment, and your committee recommend their general use.

Respectfully submitted,

H. O. WADLIE, Chairman.

MR. H. O. WADLIE, Illinois Central, and Chairman of the Committee, requested Mr. Adams to explain some drawings submitted with the report, and which were received from the Boston & Albany road.

MR. F. D. ADAMS.—Our manner of applying the check-chain is somewhat different from any other road. We make a plate of iron that is ½ of an inch in thickness and 3 inches wide, and bolt it on to the two platform sticks, the timbers to which the draw-bar is attached. This represents the edge view with two heavy hooks swaged down and forged up, making them very strong. Those are secured by two ¾ bolts, making the strain brought upon two timbers instead of one whenever a truck is thrown from the line of rail. Our chain is a ¼ chain of the best material we can get, with a very short link, giving